c.1

INSTRUCTION MANUAL

Serial Number _____

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TYPE RM561A OSCILLOSCOPE

Tektronix, Inc.
S.W. Millikan Way • P. O. Box 500 • Beaverton, Oregon • Phone MI 4-0161 • Cables: Tektronix
070-352 864

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

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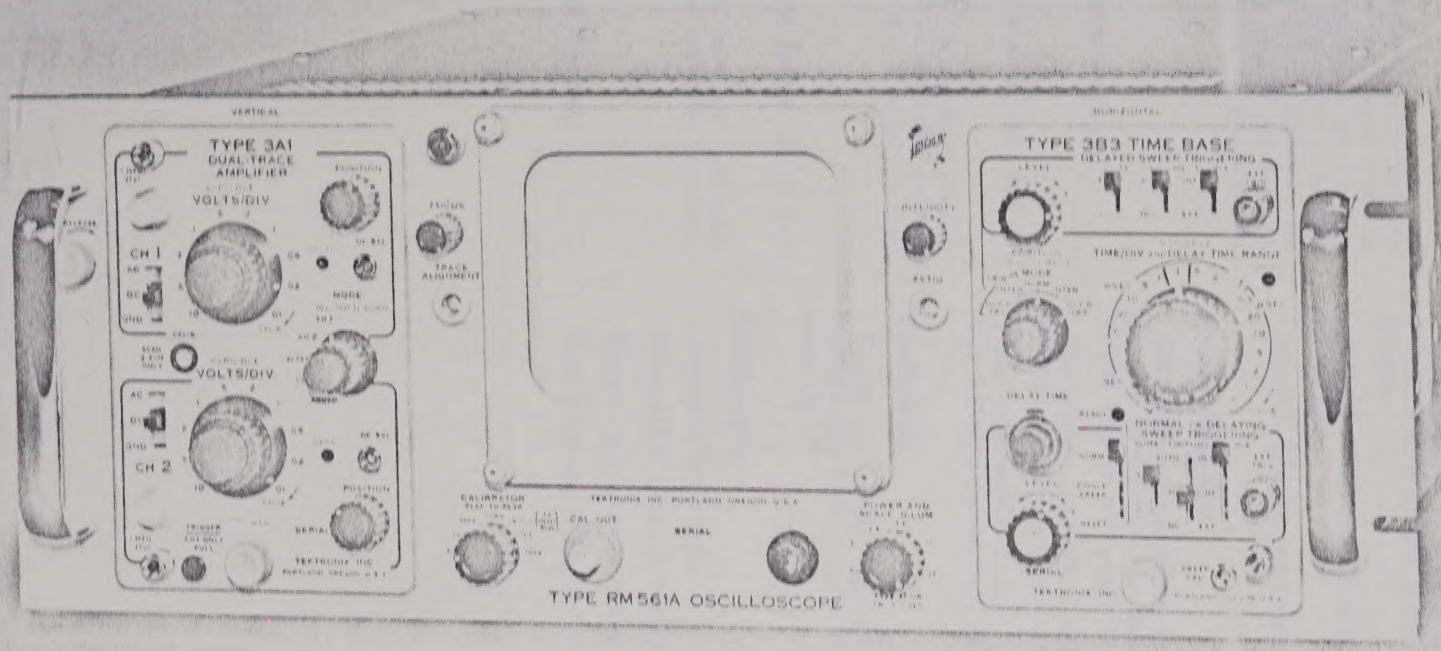
Rackmounting

A list of abbreviations and symbols used in this manual will be found on page 6-1. Change information, if any, is located at the rear of the manual.


TYPE 3A1
DUAL-TRACE
AMPLIFIER
VOLTS/DIV
CH 1
CH 2
TYPE 3B3 TIME BASE
TYPE RM561A OSCILLOSCOPE

SECTION 1

CHARACTERISTICS

General Information

The Tektronix Type RM561A Oscilloscope is essentially an indicator unit with provision for two plug-in units. The plug-in unit in the right-hand opening controls the horizontal (X-axis) deflection, and the plug-in unit in the left-hand opening controls the vertical (Y-axis) deflection. The plug-in units can be selected from any of the Tektronix '2' Series or '3' Series groups to provide the desired oscilloscope performance.

Cathode-Ray Tube

Type—T5032-31-1 (rectangular ceramic-envelope).

Phosphor—P31.

Unblanking—Deflection type, dc-coupled, with grid intensification.

Graticule—Variable edge lighted "no parallax" internal graticule. Marked in 8 vertical and 10 horizontal divisions with each major division divided into 5 minor divisions on centerlines.

Accelerating voltage—3.5 kv.

Useable viewing area—8 divisions vertical by 10 divisions horizontal.

Deflection factors—18.5 to 20.5 volts per centimeter vertical, and 17.5 to 19.3 volts per centimeter horizontal.

Calibrator

Waveform—Square waves at line frequency.

Output voltage—1 millivolt to 100 volts, peak-to-peak, in 6 steps. The 1 v position provides an output of 0.1 volt into 50 ohms.

Accuracy—Peak-to-peak amplitude within 3% of indicated voltage.

Risetime—Typically 5 microseconds.

Power Supplies

Electronically regulated for stable operation with normal line voltage variations and widely varying loads. The low voltage supplies hold regulation within ±1% of value.

Line voltage requirements—105 to 125 volts, or 210 to 250 volts, rms, 50 to 60 cps, single-phase ac.

Fuse requirements—3-amp slow-blowing type for 117 volts, 1.25-amp slow-blowing type for 234 volts.

Ventilation

Forced air cooled. Automatic-resetting thermal cutout interrupts instrument power if internal temperature exceeds about 123° F.

Construction

Aluminum-alloy chassis.

Photo-etched anodized front panel.

Weight—30½ pounds, indicator unit only.

Dimensions—see Dimension Drawing at rear of manual.

NOTES

SECTION 2

OPERATING INSTRUCTIONS

ıtroduction

Before operating the Type RM561A Oscilloscope, be sure at the instrument will cool properly, the proper line voltage used and the crt deflection potentials are correct. Function f front-panel controls and operating considerations are iven in this section.

ooling

A fan at the rear of the Type RM561A provides cooling. he entire fan assembly is in a snap-in mounting that can e mounted to exhaust air at the rear of the instrument or raw air in at the rear and blow it throughout the instruıent. Direction of air flow can be changed to meet the perating conditions.

The Type RM561A can operate in ambient temperatures up o 50° C. If the instrument overheats, the thermal cutout urns off the power. When the internal temperature drops o a safe operating level, power is automatically restored. f wired for 117-volt operation, the fan will continue to operte when the thermal cutout opens. On 234-volt operation, ower for the fan is turned off when the thermal cutout pens.

ine Voltage

The Type RM561A can be wired for either 117-volt or 234-volt operation. It will operate properly between 105 nd 125 volts when wired for 117-volt operation and beween 210 and 250 volts when wired for 234-volt operation.

Converting from one operating voltage to the other requires a change in the power transformer primary connections, fan connections, fuse and line cord plug. Figs. 2-1 and 2-2 indicate the transformer primary and fan connections for 117-volt and 234-volt operation. A 3-amp slow-blow type fuse is required for 117-volt operation and a 1.25-amp slow-blow type fuse is required for 234-volt operation.

Front Panel Controls

The POWER ON switch and SCALE ILLUM. control permit turning the instrument power on or off and provide adjustment of the brightness of the graticule markings.

The FOCUS control adjusts the trace or spot focus.

The ASTIG. control is used in conjunction with the FOCUS control, to assure proper focus over the entire crt display.

The INTENSITY control adjusts the crt display brightness.

The ALIGNMENT control permits electronic alignment of the crt trace to match the horizontal graticule markings.

The 7-position CALIBRATOR switch determines the peak-to-peak amplitude of the signal at the CAL. OUT connector. It also turns the Calibrator on or off.

Rear Panel Controls

The CRT CATHODE SELECTOR switch permits the operator to select either (1) internal DUAL-TRACE CHOPPED BLANKING to remove dual-trace chopped mode switching transients from the crt display, or (2) Z-axis intensity modulation by external signals.

Operation

Operation of the Type RM561A Oscilloscope with two plug-in units in place is much the same as that of a Tektronix oscilloscope with corresponding vertical and horizontal deflection systems built into the main frame. The plug-in

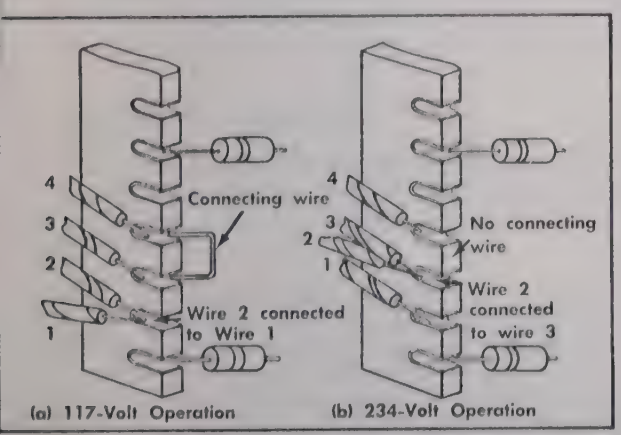


Fig. 2-1. Power transformer primary connections for operation at (a) 117 volts or (b) 234 volts.

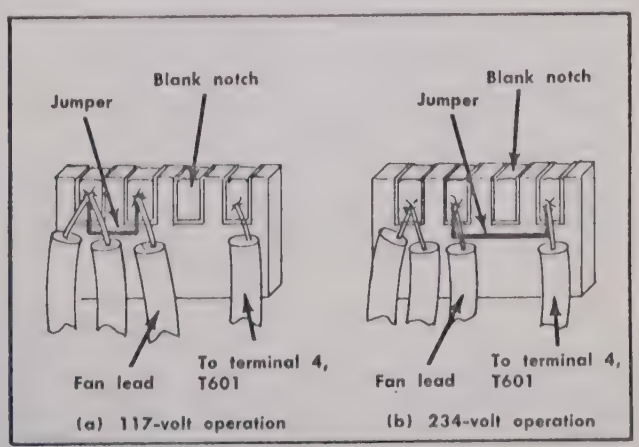


Fig. 2-2. Fan terminal strip located near thermal cutout. (a) 117 volts, (b) 234 volts.

units are the vertical and horizontal deflection systems; their outputs connect directly to the deflection plates of the cathode-ray tube. The plug-in units can be selected to give the Type RM561A Oscilloscope the degree and type of performance required for a particular application.

The controls and switches on the Type RM561A affect the display; however, the plug-in units determine the major characteristics of the system.

Calibrator Output

The Calibrator output signal of the Type RM561A provides a convenient signal source for setting the gain of an amplifier plug-in unit or the basic timing of a time-base plug-in unit. The 1 V position also provides a 0.1 volt amplitude signal when connected to a 50-ohm system. This is very useful for calibrating sampling plug-in units. See the plug-in unit Instruction Manual for complete adjustment procedure.

In addition to these applications, the Calibrator output signal can be used as a convenient square-wave signal source for other applications.

NOTE

When using the Calibrator output signal as a signal source for a system sharing a common ground with the Type RM561A (including plug-ins used in the instrument) be sure that the outer conductor of the CAL. OUT connector is connected to the chassis (or ground). Otherwise, the current through the Calibrator ground resistor, R899, may cause an incorrect Calibrator output signal.

CRT CATHODE SELECTOR Switch

The CRT CATHODE SELECTOR switch provides two modes of operation; CHOPPED BLANKING for dual-trace amplifier plug-ins and EXT CRT CATHODE for intensity modulation of the display.

The CRT CATHODE SELECTOR switch should be left in the CHOPPED BLANKING position except when external intensity modulation is used. For normal operation the shorting plug should connect the EXT CRT CATHODE jack to ground. Remove the plug for Z-axis modulation.

Display Combinations

The plug-in unit in the right opening of the Type RM561A controls the horizontal (X-axis) deflection of the crt beam. The unit in the left opening controls the vertical (Y-axis) deflection.

Conventional Display. To obtain the conventional display of a horizontal sweep with vertical deflection by the input signal, insert a time-base plug-in unit in the right-hand opening and an amplifier unit in the left. If a vertical sweep is desired with the input signal displayed horizontally, reverse the plug-ins. However, in this manner, the sweep retrace will not be blanked. Retrace blanking is provided only when a time-base unit is inserted in the right side of the Type RM561A.

X-Y Display. To obtain an X-Y display, insert amplifier plug-in units in both plug-in openings. Plug-in units with equal characteristics should be used.

Intensity Modulated Display. The crt beam can be intensity modulated (Z-axis modulated) by applying a signal to the EXT CRT CATHODE jack on the rear panel. Depending on the setting of the INTENSITY control, the crt beam can be turned on with a negative pulse, or off with a positive pulse.

To intensity modulate the display remove the shorting strap from between the EXT CRT CATHODE and GND jacks. Set the CRT CATHODE SELECTOR switch to the EXT CRT CATHODE position and apply the modulating signal to the EXT CRT CATHODE jack.

Changing Plug-in Units

Before inserting a plug-in unit into the Type RM561A Oscilloscope, make sure the latching bar (bottom front) is not pointing down. Then, push the plug-in unit all the way into the opening. Turn the aluminum knob at the bottom center of the unit clockwise until it is tight. To remove the unit, turn the knob counterclockwise several turns and pull the unit out of the plug-in compartment.

CAUTION

Although most plug-in units can be inserted or removed without damage when the power is on, best protection is provided for all units by turning the power off before changing units.

Different plug-in units apply slightly different dc voltages to the crt deflection plates. The Type RM561A crt has higher horizontal deflection sensitivity than vertical deflection sensitivity. Also, changing one plug-in unit can affect the accuracy of the other unit installed. Therefore, if one or both of the units are replaced, check the gain of both units. If a plug-in needs adjustment, follow the directions in the applicable Instruction Manual to adjust gain or sweep timing.

When the plug-in units are changed, the FOCUS and ASTIG. controls on the Type RM561A may need readjustment.

The Type RM561A can be operated with only one plug-in unit if desired. For example, moving film recording may be used in place of a sweep plug-in unit. To operate with only one plug-in unit, it will be necessary to elevate the unconnected crt deflection plates to about +170 to +210 volts dc vertical or +150 to +180 volts dc horizontal. This will provide proper action of the FOCUS and ASTIG. controls.

Blank Chassis

Blank plug-in unit chassis are available to build your own plug-in unit for use in the Type RM561A. Order Modification Kit 040-245 from your local Tektronix Field Office or representative.

SECTION 3

CIRCUIT DESCRIPTION

troduction

The Tektronix Type RM561A Oscilloscope has a low-ltage power supply circuit, a cathode-ray tube circuit, d a calibrator.

The low-voltage power supply circuit provides the regu-ed and unregulated power used by the instrument and e plug-in units.

The crt circuit has the necessary controls and input cilities needed to give a sharp trace of useable intensity. vo negative high-voltage power supply outputs are used r the cathode, focus element, and control grid of the crt.

The calibrator produces amplitude-calibrated square aves.

LOW-VOLTAGE POWER SUPPLY

The low-voltage power supply circuits have regulated tputs of —100, —12.2, +125, and —300 volts, and unregu-ed output of +420 volts. These circuits use silicon diode ctifiers and series-regulators. Each regulator circuit has a cuum tube (or transistor, in the case of the —12.2-volt pply) in series with the load. This tube's series plate re-tance (and current) is controlled to maintain a constant ltage drop across the load. For example, if the load creases the series tube plate resistance decreases to ss more current to the load. If the load decreases it sses less current. In both cases, the voltage across the ad remains the same.

The —100-, +125-, and +300-volt regulated supplies quire shunt resistors when supplying more current than n be handled by the series tube. A shunt allows some the load current to bypass the supply-series-regulator be. The size of the shunt is very important. If the shunt sistance is too high, the series tube can overheat; if the sistance is too low, the supply can fail to regulate. If a ug-in draws an amount of current that calls for a supply unt, the correct shunt resistance is located in that plug-in it. When the unit is plugged into the Type RM561A, the unt is connected around the series regulator tube. The ug-in portion of the shunt is always in series with a re-tor located in each power supply circuit.

Power for the Type RM561A Oscilloscope and its plug-in its is supplied through the power transformer T601. The o primary windings of T601 are connected in parallel for 7-volt operation, or in series for 234-volt operation, as own on the schematic diagram.

-100-Volt Supply

Reference voltage for the —100-volt supply is established the gas diode, V609. The constant voltage drop across 09 establishes a fixed potential of about —85 volts at grid of V634B. Voltage at the grid of V634A is estab-ed by the divider R616, R617, and R618. The difference voltage between the two grids of V634 determines the ate current of V634A. Plate current of V634A determines the base voltage of transistor Q624 which in turn determines the grid voltage of the series tube, V627. The series tube plate resistance changes to hold the load voltage constant. R616, —100 VOLTS adjustment, determines the percentage of the total divider voltage applied to the grid of V634A and thus controls the output voltage. When this control is properly adjusted, the output is exactly —100 volts.

Should the output voltage tend to change because of a change in input voltage or a change in load current, the potential at the grid of V634A will change a proportional amount. Any change at the grid of V634A is amplified by V634A and Q624 and applied to the grid of V627. The resulting grid change at V627 will cause its plate resistance to change in the direction needed to bring the output back to —100 volts. C616 improves the response of the regulator to sudden changes in output voltage. R628 is part of the series tube shunt, connected by some plug-in units.

+125-Volt Supply

The —100-volt supply serves as a reference for the +125-volt supply. With the R651 end of the divider R650-R651 fixed at —100 volts, any change in the +125-volt output produces a proportional change at the grid of V654. This change is amplified and supplied to the grid of the series regulator tube, V667A. The change at the grid of V667A changes its plate resistance to bring the output voltage back to +125 volts. R656, the +125 VOLTS control, determines the percentage of total divider voltage applied to the grid of V654 and permits adjustment of the output voltage. When this control is properly adjusted, the output is exactly +125 volts. C650 improves the response of the regulator to sudden changes in output voltage. R666 is part of the series tube shunt.

+300-Volt Supply

The +300-volt supply works the same as the +125-volt supply. To supply the voltage for the +300-volt regulator, rectified voltage from the transformer pins 21 and 22 is added to the voltage supplying the +125-volt regulator. R676, the +300 VOLTS control, adjusts the output voltage.

The +300-volt supply has an unregulated output of +420-volts for the crt circuit.

—12.2-Volt Supply

Operation of the —12.2-volt regulating circuit is essentially the same as that of the other regulating circuits, except that transistors are used instead of vacuum tubes. The base of Q734 is fixed near —12 volts by the voltage divider R731-R732 between —100 volts and ground. Any variation of the —12.2-volt output at the emitter of Q734 is amplified by Q734 and Q744 to change the collector resistance of Q757 which is in series with the load. R730, the —12.2 VOLTS control, allows adjustment of the voltage

applied to the base of Q734 and thus the output voltage. When this control is properly adjusted, the output is exactly —12.2 volts. F720 protects Q757 in case of an overload on the —12.2-volt supply.

CRT CIRCUIT

The crt circuit contains the cathode-ray tube and two high-voltage supplies (one for the crt and focus element, the other for the control grid). The circuit also contains the necessary controls and signal input facilities.

Cathode-Ray Tube

A Tektronix T5032-31-1 ceramic-envelope cathode-ray tube is used in the Type RM561A. The accelerating voltage is approximately 3500 volts, developed by about —3300 volts at the cathode and an average deflection plate voltage of about +200 volts. With this accelerating voltage, the nominal vertical and horizontal deflection factors are 19.5 and 18.4 volts per centimeter respectively.

Deflection blanking of the crt beam is used in the Type RM561A. The crt contains a special set of deflection plates, pins 6 and 7, for this purpose. Both plates are connected to +125 volts; however pin 6 is also driven by the horizontal plug-in unit.

During sweep time, or if no plug-in unit is installed, both plates rest at +125 volts and permit the electron beam to pass on to the crt phosphor. During sweep retrace, however, pin 6 is driven considerably away from +125 volts by the right-hand plug-in unit. This scatters the beam and prevents it from being displayed.

High-Voltage Supplies

Energy for both high-voltage supplies is furnished by T801. V800, the primary of T801, and the stray circuit capacitance form a Hartley oscillator which operates at about 45 kc.

The output of one secondary winding of T801, rectified by V822, provides voltage for the crt cathode and focus element. This voltage is about —3300 volts at the crt cathode, and between about —2200 and —3000 volts at the focusing element, depending on the setting of the FOCUS control. The 6.3-volt crt heater is elevated to the cathode potential by R851.

The output of the other secondary winding of T801 is rectified by V832 for the control grid. The grid voltage ranges from —3200 to —3450 volts, depending on the setting of the INTENSITY control. The reference to ground for this supply is determined by the voltage at the junction of diodes D838 and D839. The voltage at this junction, plus the setting of the INTENSITY control, determines the crt bias and therefore the intensity of the display.

Two neon bulbs, B856 and B857, keep the voltage between the grid and cathode of the crt within safe limits. If the voltage exceeds about 140 volts, the neons fire and the voltage reduces to about 120 volts.

Regulation of the —3300-volt supply is accomplished through feedback from the arm of R841. The —3450-volt supply is regulated indirectly by mutual coupling in T801. If, because of loading or a change in input voltage, the output of the —3300-volt supply changes, a proportionate change occurs at the arm of R841. This change is amplified by V814 and is coupled to the screen of V800. The resulting change in screen voltage of V800 will increase or decrease the amplitude of oscillations in V800, changing the output voltage of T801 in the direction needed to return the high voltage to the correct level. The HIGH VOLTAGE control, R841, permits adjustment of the output voltage by setting the bias on V814B.

Deflection Signals

Push-pull signals for the deflection plates appear at pins 17 and 21 of the plug-in connector. The effective deflection-circuit capacitance these signals see at the connector affects the bandpass and phase shift of each plug-in unit. C760 and C761 (Interconnecting Socket diagram) are set at the factory.

Intensifying Signals

Two signals may be used to modulate the intensity of the crt display. First, intensifying signals from a two-sweep (delaying-sweep) time-base plug-in unit are applied to the grid supply through pin 14 of the right-hand Interconnecting Socket. When the overall display intensity is reduced with the INTENSITY control, positive intensifying pulses from a two-sweep time-base plug-in unit will brighten any desired portion of the display.

The ground return for the crt grid supply can be either through D838 in the case where the plug-in unit does not supply intensifying signals or through D839 to a negative voltage in the intensifying circuit of the plug-in unit. In the second case D838 is back-biased and the junction of D838 and D839 is at a low negative voltage. With the same setting of the INTENSITY control, the first case will provide a brighter display. The second case provides a slightly dimmer display due to the plug-in unit negative voltage. Intensification results when the plug-in unit positive pulse turns D839 off and the crt grid supply return again becomes D838. R837 and C837 then couple the leading edge of the intensifying pulse directly to the crt grid.

Other external intensifying signals can be fed to the crt cathode through the EXT CRT CATHODE jack. Depending on the setting of the INTENSITY control, a negative pulse of 5 volts or more will turn the crt beam on.

Crt Controls

The INTENSITY control, R833, has a range of about 250 volts to control the crt bias and permit changing the intensity of the display.

The FOCUS control, R844, adjusts the focus of the crt by varying the voltage at the focusing anode through a range from about —2200 to —3000 volts.

The ASTIG. control, R864, has a 300-volt adjustment range.

The GEOMETRY control, R865, adjusts the geometry by rying the voltage of the crt isolation shield through a nge from +180 to +246 volts.

The TRACE ALIGNMENT control, R860, rotates the dis- ay so it can be aligned with the graticule.

CALIBRATOR

The calibrator for the Type RM561A Oscilloscope pro- uces line-frequency amplitude-calibrated square waves. he 6.3-volt (approximately 18 volts peak-to-peak) ac heater oltage for V884 is applied through C876 to the cathode V884A. The signal at the plate of V884A is coupled to the grid of V884B to turn that tube on and off. Regenerative feedback from the plate of V884B to the grid of V884A speeds up the switching action, and drives V884A into and out of cutoff.

The voltage present at the cathode of V884B during the time that V884B is conducting is adjusted to exactly 100 volts with the CAL. AMPL. adjustment, R871. The voltage divider in the cathode circuit of V884B contains precision resistors to provide an output accuracy of 3% or better at the various settings of the CALIBRATOR control.

When the CALIBRATOR control is set to the 1V position, there will be a 0.1-volt output when the CAL. OUT connector is terminated in 50 ohms.

SECTION 4
MAINTENANCE

PREVENTIVE MAINTENANCE

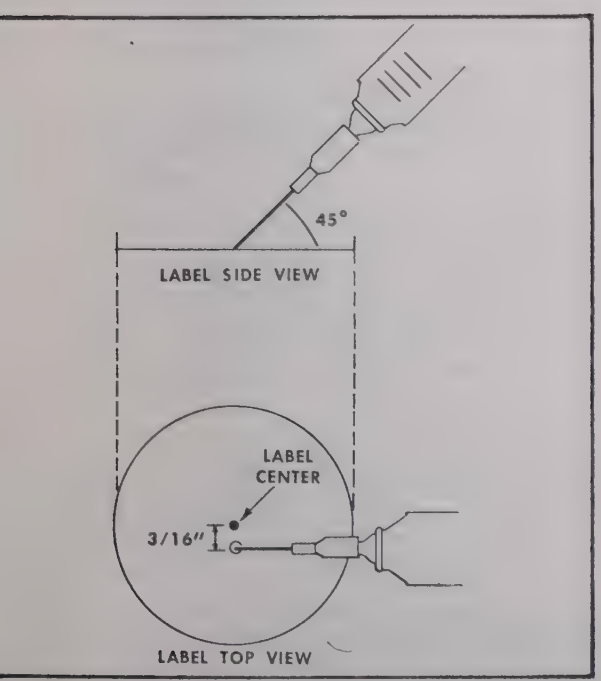
leaning

Occasionally blow the dust out of the instrument with a w-velocity dry air stream. Remove persistent dirt with a all paint brush or damp cloth. The screen on the fan n be snapped out and should be cleaned as needed. neck it frequently.

an Oiling

The fan should be oiled with a few drops of oil about very six months. An industrial hypodermic syringe and eedle is used to insert oil through a protective rubber cap cated under the fan label. The oil recommended is Anderol 26 from the Lehigh Company or Rotron distributors, but not available, a good light machine oil may be used. a syringe and needle cannot be obtained locally, you n order them through your local Tektronix Field Office by ecifying Hypodermic Syringe, Tektronix Part No. 003-282 nd Hypodermic Needle, Tektronix Part No. 003-285.

Fig. 4-1 shows how to oil the fan. Place the needle at e point on the label shown in Fig. 4-1. With the needle at bout 45°, pierce the label and rubber cap (located under e label); insert the needle about ¼" and depress the ringe-plunger to inject a few drops of oil.



g. 4-1. Fan motor oiling with hypodermic.

CORRECTIVE MAINTENANCE

Replacing Parts

Most parts in the Type RM561A Oscilloscope can be replaced without detailed instructions. Some parts, however, should be replaced by using definite procedures. These procedures are described in the following paragraphs.

A replaced part may affect instrument calibration. Check and adjust where needed.

Soldering Precautions and Procedure

In Tektronix instruments, parts are connected to ceramic terminal strip notches with solder containing about 3% silver. The bond between the notch and ceramic strip may be broken by repeated use of ordinary 60-40 tin-lead solder or by excessive heat. Therefore, when resoldering parts to a ceramic strip use solder containing 3% silver and do not overheat the work. Occasional use of ordinary solder, however, will not break the bond.

Usually 3% silver solder is available locally; or one-pound rolls may be purchased through your Tektronix Field Office by ordering Tektronix Part Number 251-514.

The following soldering procedure may be used to remove and replace parts on a ceramic terminal strip.

1. Use 50- to 70-watt soldering iron with a wedge shaped tip. (With this type tip you can heat the solder slot without overheating the strip.)

2. Tin the soldering iron tip with silver-bearing solder.

3. Heat the parts soldered to the ceramic strip only enough to make the solder flow freely. Do this by touching one corner of the soldering iron tip to the notch. (Be careful: excessive pressure will break the ceramic strip.)

4. When you remove a part, pull its lead out of the notch while the solder is hot.

5. When you replace a part use only enough solder to cover the wires and form a small fillet in the notch.

6. Clip excess leads of parts replaced and be sure to remove all clippings from the instrument.

Replacing Ceramic Terminal Strips

Damaged ceramic terminal strips can be replaced by the following procedure. Fig. 4-2 shows how ceramic strip parts are assembled.

1. Unsolder all connections to damaged ceramic strip.

2. Cut off one side of each plastic yoke holding the old ceramic strip.

3. Remove old ceramic strip.

4. Remove remainder of old yokes from spacers.

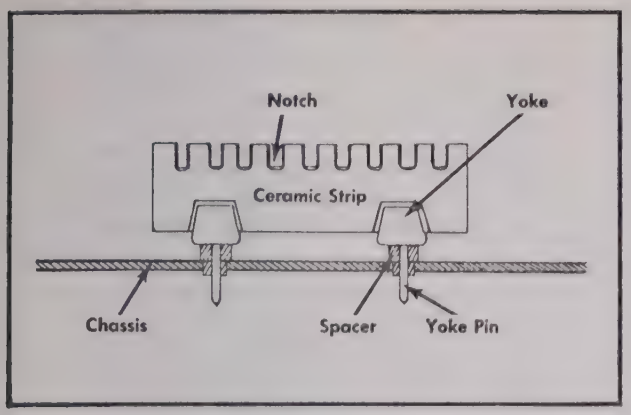


Fig. 4-2. Ceramic terminal strip assembly.

5. Replace old spacers with new ones. (If not damaged, spacers can be reused.)

6. Set new ceramic strip yoke pins into spacers.

7. Drive new yoke pins completely into spacers by pressing or lightly tapping the ceramic strip directly above the yokes. Be careful, don't break strips.

8. Cut off portion of new yoke pins protruding through spacers on side of chassis opposite the ceramic strip.

9. Resolder connections to new ceramic strip using the information headed Soldering Precautions and Procedure.

Replacing Calibrator Switch

The entire switch should be replaced and can be ordered either wired or unwired.

Cathode-Ray Tube

WARNING

When replacing crt, wear a plastic face mask and protective gloves for protection in case tube implodes.

To remove the cathode-ray tube, disconnect the four leads connected to the neck of the tube, the tube socket, and loosen the tube clamp on tube base. Remove the crt bezel, light reflector and light shield. Pull the crt straight out through the front panel, being careful not to bend or break the crt neck pins. The rubber gasket and implosion shield can be removed from the crt face after it is out of the instrument.

Install the new crt by the reverse of the preceding procedure. When replacing the implosion shield be sure that the notched side is down. Follow the color-code information on the tube shield when the crt neck pin leads are replaced. When the crt is properly installed, the back of its faceplate is flush with the instrument front panel.

After the crt is replaced, it may be necessary to adjust the TRACE ALIGNMENT and HIGH VOLTAGE controls and the deflection-circuit capacitance (C760 and C761) according to the calibration procedure. Also check the calibration of time-base and amplifier plug-in units.

TROUBLESHOOTING

If trouble occurs in the Type RM561A Oscilloscope, a five-step procedure may be used for repair. First confirm the trouble. Next, isolate trouble to a plug-in unit or to the Type RM561A. Localize a trouble in the Type RM561A to the Power Supply, Crt Circuit, or Calibrator. Troubleshoot the correct circuit to find defective parts. Replace the defective parts.

Confirmation of Trouble

Improper control settings may, at times, give indications of trouble. Therefore, you should be sure that the apparent trouble is not caused by improper front-panel control settings. For example, an improper setting of the SOURCE or COUPLING switch on a time-base unit can cause apparent triggering troubles; an improper setting of the VARIABLE control on an amplifier unit can cause an apparent decrease in sensitivity.

When a trouble exists, it must be isolated to one of the plug-in units or to the Type RM561A indicator.

Isolating Trouble

Isolating trouble to a plug-in unit or to the indicator can be done in one of two ways, depending on whether or not there are spare plug-in units available.

If trouble is found to be in the plug-in unit, refer to the instruction manual for that unit. A plug-in extension (Part Number 013-034, available through your local Tektronix Field Office) allows the units to be operated while extended out through the front of the plug-in opening.

Spare Plug-In Units Available

If more than two plug-in units are available, the easiest way to isolate trouble is to replace the plug-in units one at a time. The faulty unit can then be isolated by noting when proper operation is restored. If plug-in replacement does not correct the trouble, the Type RM561A is probably faulty.

NOTE

A non-sampling plug-in unit cannot be operated with a sampling plug-in unit.

Spare Plug-In Units Not Available

When spare plug-in units are not available, the crt display will be of great help. Trouble will normally show up as an erroneous display, or as no display at all. Since the crt display will help isolate the trouble, the following procedure is divided according to the type of display.

No Trace Or Spot. If no trace can be obtained on the crt, remove both plug-in units and vary the INTENSITY control. A spot should appear. If no spot appears, the trouble is in the Type RM561A. If a spot does appear when both plug-in units are removed reinsert each unit separately. After warm up, vary its POSITION control. If the spot or

ce cannot be returned to the approximate center of the when a single plug-in unit is in the indicator, the trouble probably in that unit. (If a time-base unit is installed, be e it is set for free-running operation to unblank the crt.)

Insufficient Vertical Deflection or Improper Sweep ning. If the plug-in unit front-panel gain controls do not rmit adequate vertical deflection or proper sweep timing, ck the low-voltage and high-voltage power supply volt- es (see schematics).

If the power-supply voltages are not correct, remove both g-in units and check the voltages again. If they still are t correct, the trouble is in the Type RM561A indicator. the power-supply voltages are correct with both plug-in its removed, but incorrect with only one of the two in- rted, the trouble is in that unit. If the power-supply volt- es are correct with both plug-in units removed, but in- rrect when either is inserted, the trouble is probably in e power supply of the Type RM561A.

Improper Triggering. If external triggering and line ggering are satisfactory, but internal triggering is not, e trouble is probably in the Trigger Pickoff Circuit of the mplifier plug-in units. If satisfactory triggering cannot be obtained from any of the three sources (external, internal or line) the trouble is probably in the time-base plug-in unit.

Waveform Distortion. If there is any waveform distortion, but no other indications of malfunction (such as improper sweep timing) the trouble is probably in the vertical plug-in unit.

Localizing Trouble In Type RM561A Indicator

If it has been determined that trouble exists in the Type RM561A, the location of the trouble can be further localized to the Power Supply, the Crt Circuit, or the Calibrator.

To localize the trouble to either the Power Supply or the Crt Circuit, measure the output of each of the regulated power supplies. If incorrect supplies are measured, the trouble is in the Power Supply or the power source. If all of the measured voltages are proper, the trouble is in the Crt Circuit.

Trouble in the Calibrator is indicated by an erroneous output at the CAL. OUT connector.

When it is known which circuit contains the trouble, that circuit can be checked to locate the defective component.

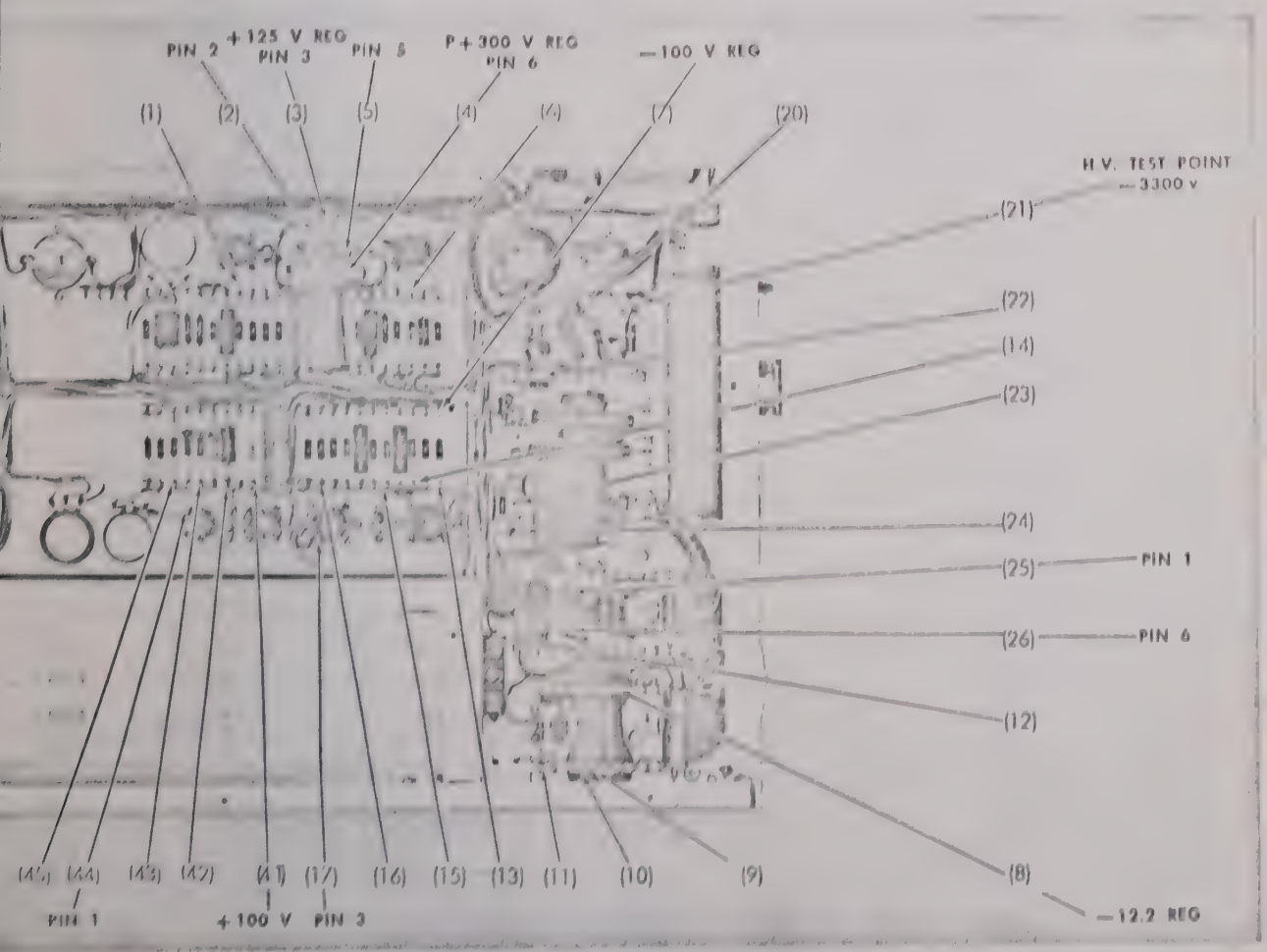


Fig. 4-3. Power-Supply test points (1) through (17). CRT Circuit test points, (20) through (26). Calibrator test points (41) through (45).

Circuit Troubleshooting

In troubleshooting a circuit, broken wires, worn switches, scorched parts, and improperly seated tubes can be found by visual inspection. (Before a scorched part is replaced, the cause of the scorching should be eliminated.)

Tube failure is the most prevalent cause of trouble in Tektronix instruments. Therefore, if a visual check fails to reveal the cause of trouble, all tubes should be checked as the next step. Tubes should be checked by substitution, one at a time. (Tube-testers cannot adequately check all parameters.) Be sure to return all good tubes to their original sockets; otherwise the instrument may have to be recalibrated unnecessarily because of different characteristics of the same tube type.

If tube substitution does not correct the trouble, then check the rest of the circuit by voltage and resistance measurements. Voltages at various test points throughout the instrument are indicated on the schematics. The test points can easily be located using Fig. 4-3. The voltages at the test points are typical and may vary considerably from instrument to instrument. Resistance measurements in a circuit will usually be point-to-point checks for which the proper values can be approximated from the schematic diagrams. Table 4-1 may be used as an aid in relating trouble symptoms to the probable cause and the procedure to use to locate the defective component. Voltages listed in the table were obtained with the Type RM561A operated without plug-in units.

All signal wiring in the Type RM561A is colored to make circuit tracing easier. In addition, all regulated power supply leads are color coded to follow the standard EIA code. The first color (widest stripe) indicates the first number of the voltage. The second color indicates the second and the third color (smallest stripe) indicates the multiplier. The voltage is positive if the main color of the wire is white and negative if the main color of the wire is tan. Four colors would be required to indicate all the digits plus a multiplier for the +125-volt leads. To avoid this, the +125-volt leads are coded as +120; that is, brown, red, brown on a white base. A —100-volt lead is coded brown, black, brown on a tan base while +300-volt leads are coded orange, black, brown on white.

The switch wafer shown on the Calibrator diagram is coded. The letters F and R indicate whether the front or rear of the wafer is used to perform the particular switching function.

TABLE 4-1

RM561A Troubleshooting Table

Symptoms	Checks
	—100-Volt Supply (Any change in this supply may change instrument calibration.)
1. Incorrect output level, ripple, or regulation.	a. Check line voltage. b. Check Setting of —100 volts adjustment (see Calibration Procedure). c. Check V609, V634, V627 and Q624 by substitution. d. If output still incorrect go to whichever symptoms apply of 2 through 7.
2. Output voltage high (too negative).	a. Check voltage at test point (14): about —80 vdc. (Incorrect: check V634B grid circuit components.) b. Measure V634 bias, between pin 7 of V609 and pin 8 of V634: about 2 v. Use meter that can be elevated. (If bias is excessive check R618 and R616.) c. Check R618, R616, R634, R633, and R624.
3. Output voltage low (too positive).	a. Check voltage between pins 17 and 18 of T601. 137 vac ±10% check T601 primary circuit.) b. Check voltage between C640A terminals: about 175 vdc ±10%. (Incorrect: check C640A, C640B, R640, and D640.) c. Check test point (14): about —80 vdc. (Incorrect: check V609.) d. Check R617, R616, C616, C640B.
4. Poor regulation at either high, low or normal line voltage. (Supply should hold regulation within ±1% throughout normal line voltage range.)	a. Check for correct output voltage before checking regulation—also, check output voltage after regulation trouble is fixed. b. Check voltage at test point (17): about +85 vdc. (Voltage low: check D640 and do checks 2A, 2B, and 2C.) c. Check for excessive loading by either plug-in unit or RM561A circuits.
5. Poor regulation at low line voltage.	Check R635, R628 and shunt resistors in plug-in unit.
6. Poor regulation at high line voltage.	Substitute another plug-in unit. (Symptom occurs if load is reduced while shunt resistor remains the same in plug-in unit.)
7. Excessive ripple.	a. Check for correct output voltage and regulation before checking ripple—also check output voltage and regulation after ripple trouble is fixed. b. Check voltage at test point (17): about +85 vdc. c. Check ripple at test point (17): should be less than 25 v peak-to-peak with load. (Excessive: check C640A and D640.) d. Check tubes. e. Check C616, C611, C640A and C640B.
	+125-Volt Supply (Any change in this supply may change instrument calibration.)
8. Incorrect output level, ripple, or regulation.	a. Check line voltage. b. Check —100 volt supply voltage and ripple at test point (7). c. Check setting of +125 VOLTS ad-

Symptoms	Checks
	justment (see Calibration Procedure). d. Check V654, V667. e. If output still incorrect go to whatever symptoms apply of steps 9 through 14.
. Output voltage igh.	a. Check voltage at test point (1): about +68 vdc. (Incorrect: check R657, R658, and V654.) b. Check R650.
0. Output voltage ow.	a. Check voltage between pins 19 and 20 of T601: 160 vac ±10%. (Incorrect: check primary circuit.) b. Check voltage at test point (2): +215 vdc. (Incorrect: check C642A, R642, D642.) c. Check test point (1): about +68 vdc. (Incorrect: check R659, V654.) d. Check C650, R651.
1. Poor regulation t either high, low or ormal line. (Supply hould hold regulaon within 1% hroughout normal ne voltage range.)	a. Check for correct output voltage before checking regulation — also, check output voltage after regulation trouble is fixed. b. Check tubes. c. Check voltage at test point (2): about +215 vdc. (Incorrect: do checks 10A and 10B.)
2. Poor regulation t low line voltage.	Check R653, C650, R666, and shunt resistors in plug-in units.
3. Poor regulation t high line voltage.	a. Check C650. b. Substitute another plug-in unit. (Symptom occurs if load is reduced while shunt resistor remains the same in plug-in unit.)
4. Excessive ripple.	a. Check for correct output voltage and regulation before checking ripple —also, check output voltage and regulation after ripple trouble is fixed. b. Check tubes. c. Check voltage at test point (2): about +215 vdc. (Incorrect: do checks 10A and 10B.) d. Check voltage at test point (1): about +68 vdc. (Incorrect: check R657, R659, R658.) e. Check C642A, and B, C650, D642.
+300-Volt Supply Symptoms and checks similar to those described for the +125 volt supply.	
—12.2-Volt Supply (Any change in this supply may change instrument calibration.)	
5. Incorrect output evel, ripple or regulation.	a. Check line voltage. b. Check —100 volt supply output test point (7). c. Check setting of —12.2 VOLTS adjustment (see Calibration Procedure).

Symptoms	Checks
	d. Check Q734, Q744, Q757, and F720. e. If output still incorrect go to whichever symptoms apply to steps 16 through 20.
16. Output high (too negative).	a. Check test point (9): about —12 vdc. (Incorrect: check C732, R732.) b. Check test point (10): about +7.9 vdc. (Incorrect: check R734, C737.) c. Check C737, R734, R744.
17. Output low or zero, (too positive).	a. Check voltage between pins 14 and 15 then 15 and 16 of T601: 15 vac ±10% with 117 (234) vac line. (Incorrect: check transformer primary circuit.) b. Check voltage between C720A and B terminals, test points (8) and (12): about 18 vdc. (Incorrect: check C720A, C720B, D720, D721.) c. Check voltage at fuse F720: about +8.2 vdc. (Incorrect: check C757 and F720.) d. Check test point (9): about —12 vdc. (Incorrect: check R731.) e. Check test point (10): about +7.9 vdc. (Incorrect: check R735.) f. Check C757.
18. Poor regulation at either high, low or normal line voltage. (Supply should hold regulation within ±1% throughout normal line voltage range.)	a. Check for correct output voltage before checking regulation — also, check output voltage after regulation trouble is fixed. b. Check for excessive loading by either plug-in units or RM561A circuits.
19. Poor regulation at low or high line voltage.	Check R734, R735, R744, and C737.
20. Excessive Ripple.	a. Check for correct output voltage and regulation before checking ripple —also, check output voltage and regulation after ripple trouble is fixed. b. Check ripple at test point (12): should be less than 4 v peak-to-peak with load. (Excessive: do checks 17A and B.) c. Check D720, D721, C720A and B, C732, C757.
CRT Circuit (Any change in this circuit may change display vertical and horizontal calibration.)	
21. Any incorrect operation of CRT circuit.	a. Check line voltage. b. Check HIGH VOLTAGE adjustment, (—3300 volts at test point (21), see Calibration Procedure). If minor adjustment restores operation circuit may be normal. c. Check V822 and V832 heaters for color: dull orange—normal

Symptoms	Checks
	bright—heavy load on either tube dim—poor tube (replace) both dark—oscillator inoperative d. If operation still incorrect, go to whichever symptoms apply of 22 through 29.
22. Low intensity.	a. Check intensity control setting. b. Check V822 and R835. c. Unblanking pulse doesn't return pin 6 of crt fully to +125 v. d. Check crt.
23. High intensity.	a. Check intensity control setting. b. Check R833, C837, C830 and C832.
24. No intensity.	a. Check intensity control setting. b. Make sure spot or trace is not deflected off screen. (Spot should appear near center with both plug-in units removed.) c. V822 heater open, (B856 and B857 glowing brightly show V822 open). If V822 is open check V814A. d. Check oscillator tubes and circuit including T801. e. Check C822, C842 and crt.
25. Poor astigmatism and/or focus.	a. Check FOCUS and ASTIG. control settings. b. Check HIGH VOLTAGE at pin 2 of crt, test point (20): —3300 vdc. (Incorrect: check R852). c. Check voltage at pin 9 of crt: 0 to +300 vdc when ASTIG. control is rotated. (Incorrect: check R864 and +300 vdc to R864.)
26. Blooming (size of display increases with intensity increase).	Check V800 and V822 (either may be weak).
27. No intensifying pulse.	a. D838 shorted, D839 open. b. C837 or R837 open (leading edge of long intensifying pulse missing).
28. No Z-axis modulation or no chopped blanking.	C853 or R853 open. If R853 open check for shorted C853.
29. Intensity varies (unwanted Z-axis modulation).	D838 and/or D839 open.
CALIBRATOR	
30. Incorrect outputs.	a. Check CAL. AMPL. adjustment (see Calibration Procedure). b. Check V884. c. Check voltages at test points (41 through 45). d. Use Calibration Procedure, check divider in V884B cathode.

SECTION 5

CALIBRATION

Introduction

The Type RM561A should be calibrated every 500 hours of operation or every six months if used intermittently. If transistors, tubes or other components are replaced, the calibration of the repaired circuit should be checked.

When calibrating both the Type RM561A and the plug-in units, always calibrate the Type RM561A first. The plug-in units used to calibrate the Type RM561A need not be calibrated, but must be working properly.

EQUIPMENT REQUIRED

The following equipment, or equivalent, is required for a complete calibration of the Type RM561A.

1. Tektronix 2- or 3-series amplifier plug-in unit such as a Type 3A1.

2. Tektronix 2- or 3-series time-base plug-in unit such as a Type 3B3.

3. Variable autotransformer. Must be capable of supplying at least 350 volt-amperes. If autotransformer does not have an ac voltmeter to indicate voltage, monitor output with an ac voltmeter (rms) with range of at least 125 volts. Type RM561A is wired for 117-volt operation (250 volts if wired for 234-volt operation).

4. Dc voltmeter. Minimum sensitivity of 20,000 Ω/volt and accuracy of 1% or better up to 300 volts and at least 3% at 4 kv.

5. Capacitance Meter. Range, 0-30 picofarads. Recommended type; Tektronix Type 130 L-C Meter.

6. 1X probe, BNC connector. Tektronix P6028.

PRELIMINARY PROCEDURE

1. Remove the top and bottom dust covers from the Type RM561A.

2. Insert the 2- or 3-series amplifier plug-in unit in the left plug-in compartment.

3. Insert the 2- or 3-series time-base plug-in unit in the right plug-in compartment.

4. Preset the Type RM561A controls as follows:

INTENSITY	Midrange
CALIBRATOR	OFF
POWER	Off
CRT CATHODE SELECTOR	Up

5. Preset the amplifier unit Ch 1 controls as follows: (Control settings given for a Type 3A1. Use equivalent settings with other amplifier units.)

Position	Midrange
Ac Dc Gnd	Ac
Volts/Div	.1
Variable	Calib
Mode	Ch 1
Inv (Ch 1) Norm	Norm
Trigger	Pushed in

6. Preset the time-base unit controls as follows: (Control settings given for a Type 3B3. Use equivalent settings with other time-base units.)

Mode	Norm
Position	Midrange
Pull 5X Mag	In
Time/Div	10 mSEC
Variable	Calib
Triggering Controls	Set for auto or free-run

7. Connect the autotransformer to a suitable power source.

8. Connect the Type RM561A power cord to the autotransformer output.

9. Set the autotransformer output voltage for the nominal operating voltage of the Type RM561A (117 or 234 volts).

10. Turn the Type RM561A POWER switch ON. Allow about 15 minutes warm up before making adjustments.

CALIBRATION PROCEDURE

1. Adjust —100-Volt Power Supply

a. Connect the dc voltmeter between pin 23 of either interconnecting plug and ground.

b. Adjust —100 VOLTS control R616 for exactly —100 volts.

2. Adjust +125-Volt Power Supply

a. Connect the dc voltmeter between pin 15 of either interconnecting plug and ground.

b. Adjust +125 VOLTS control R656 for exactly —125 volts.

3. Adjust +300-Volt Power Supply

a. Connect the dc voltmeter between pin 10 of either interconnecting plug and ground.

b. Adjust +300 VOLTS control R676 for exactly +300 volts.

4. Adjust —12.2-Volt Power Supply

a. Connect the dc voltmeter between pin 16 of either interconnecting plug and ground.

c. Adjust —12.2 VOLTS control R730 for exactly —12.2 volts.

5. Adjust High-Voltage Power Supply

a. Connect the dc voltmeter between the HV TEST POINT (test point (21) Fig. 4-3) and ground.

b. Set the HIGH VOLTAGE control R841 for —3300 volts.

6. Check Power Supply Ripple

NOTE

The gain of the amplifier plug-in unit should be checked before proceeding with this step. See the plug-in unit instruction manual.

a. Connect the P6028 Probe to Ch 1 input of the amplifier plug-in unit.

b. +300-volt supply—Connect the probe tip to pin 10 of either interconnecting plug. Peak-to-peak ripple voltage should not exceed 80 millivolts (0.8 division).

c. —100-volt supply—Connect the probe tip to pin 23 of either interconnecting plug. Set the amplifier unit Volts/Div switch to .01. Peak-to-peak ripple voltage should not exceed 5 millivolts (0.5 division).

d. +125-volt supply—Connect the probe tip to pin 15 of either interconnecting plug. Peak-to-peak ripple voltage should not exceed 10 millivolts (1 division).

e. —12.2-volt supply—Connect the probe tip to pin 16 of either interconnecting plug. Peak-to-peak ripple voltage should not exceed 3 millivolts (0.3 division).

CAUTION

Do not attempt to measure ripple of the —3300-volt supply.

7. Check Power Supply Regulation

a. Vary the autotransformer output voltage between 105 and 125 volts (210 and 250 volts if wired for 234-volt operation).

b. Check each power-supply output voltage at both voltage extremes to see that it stays within ±3% of regulated value.

8. Adjust Calibrator Amplitude

a. Connect the dc voltmeter between pin 7 of V884 and ground.

b. Be sure the CALIBRATOR switch is set to OFF.

c. Adjust CAL AMPL control R871 for exactly +100 volts.

9. Adjust Trace Alignment

a. Adjust the time-base plug-in unit controls for a free-running or automatic triggered trace.

b. Align the trace with the graticule horizontal centerline with the amplifier plug-in unit Position control.

c. Adjust the Type RM561A INTENSITY, FOCUS, and ASTIG. controls for the best display.

d. Adjust the ALIGNMENT control R860 so that the trace is parallel with the horizontal graticule lines.

10. Adjust Cathode-Ray Tube Geometry

a. Move the trace to the vertical center of the crt.

b. Connect a jumper lead between the vertical deflection pins on the neck of the crt.

c. Measure the voltage betwen the vertical deflection pins and ground.

d. Connect the meter to the variable arm of GEOMETRY control R865.

e. Adjust the GEOMETRY control for the same meter reading as in step 'c'.

11. Adjust Deflection-Plate Capacitance

The effective deflection-plate capacitance of the cathode-ray tube as seen by the plug-ins, can be adjusted by means of C760 and C761. These capacitors have been factory set to provide an effective deflection-plate capacitance of 14.3 picofarads. However, if C760 or C761 has been inadvertently misadjusted, or if the crt has been replaced, the effective capacitance of one or both pairs of deflection plates may be incorrect. This will be apparent by a loss of high-frequency response when using a wideband amplifier plug-in (4 Mc or higher) near the upper limit of its bandpass. If proper high-frequency response cannot be obtained the effective deflection-plate capacitance may need readjustment.

Since the effective deflection-plate capacitance of the crt is the capacitance seen by the plug-in unit when the deflection plates are driven push-pull, it cannot be measured directly with a capacitance meter. However, the individual circuit capacitances which make up the effective deflection-plate capacitance can be measured. These individual circuit capacitances are shown schematically in Fig. 5-1. C1 and C2 represent the capacitance from each deflection plate to ground. C3 represents the capacitance between the deflection plates. The variable capacitor is made up of the circuit capacitance plus the capacitor added for adjustment.

The variable capacitor for the vertical (left) plug-in compartment may be C3 (Fig. 5-1a) or C2 (Fig. 5-1b) depending on other circuit capacitance values. Check the instrument to determine the configuration and formula to use to adjust the variable capacitor for correct deflection-plate capacitance.

The effective deflection-plate capacitance, C_{eff}, can be expressed in terms of C1, C2 and C3 as follows:

$$C_{eff} = \frac{C1 + C2}{2} + 2\ (C3)$$

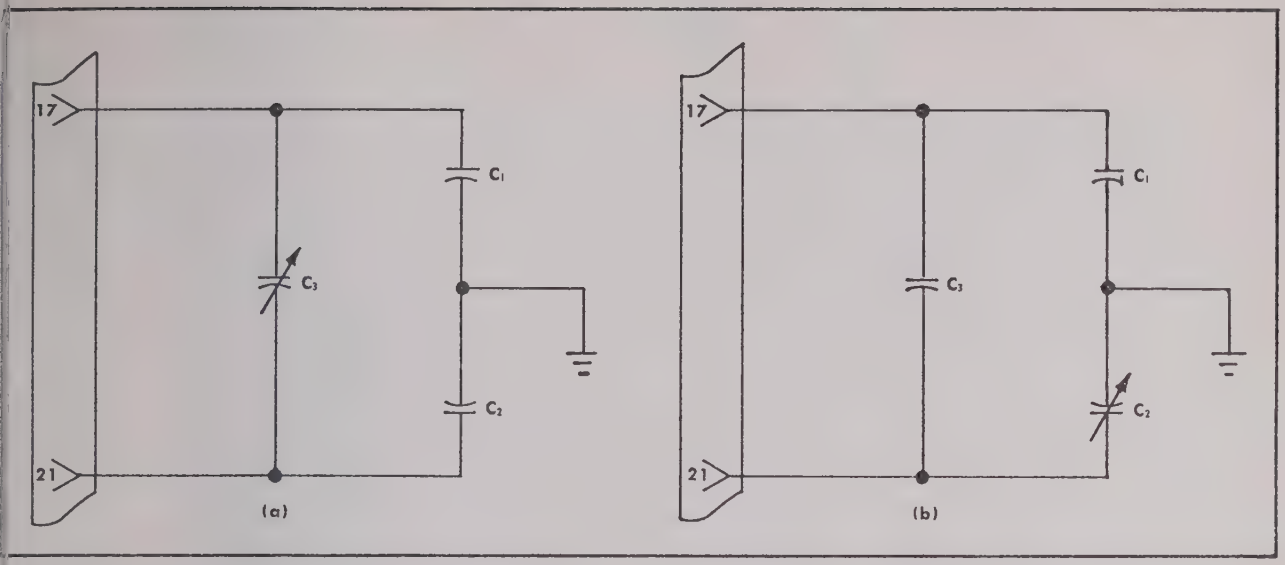


Fig. 5-1. Schematic representation of the crt effective deflection plate capacitances. (a) Configuration 1, (b) Configuration 2.

Setting C_{eff} equal to 14.3 picofarads (value set at factory), the value of the variable capacitor can be calculated.

Configuration 1, Fig. 5-1a. $C3 = 7.15\,pf - \frac{C1 + C2}{4}$

Configuration 2, Fig. 5-1b. $C2 = 28.6\,pf - 4\,(C3) - C1$

Adjustment Procedure

NOTE

The Type 3M1 Capacitance Standardizer can be used in place of this adjustment procedure. Also, a wide-band amplifier plug-in (4 Mc or higher) which has been calibrated in a standardized indicator unit can be used by applying the same square-wave signal used in the plug-in unit calibration and adjusting C760 or C761 for best square-wave response.

a. Disconnect the power cord and isolate the Type RM561A from ground.

b. Remove both plug-in units.

c. Connect the capacitance meter guard voltage to pin 21 of the Vertical plug-in compartment and measure the capacitance between pin 17 and the oscilloscope chassis—this is C1.

d. Connect the capacitance meter guard voltage to pin 17 and measure the capacitance between pin 21 and the oscilloscope chassis—this is C2. (For configuration 2, connect the guard voltage to the oscilloscope chassis and measure the capacitance between pin 17 and 21—this is C3.)

e. Substitute the measured capacitance values into the equation and solve for C3 (configuration 2, solve for C2).

f. Connect the guard voltage to the oscilloscope chassis and measure the capacitance between pins 17 and 21. (For configuration 2, connect the guard voltage to pin 17 and measure the capacitance between pin 21 and the oscilloscope chassis.)

g. Adjust C760 until the measured capacitance equals the value calculated for C3 in step e (configuration 2, adjust C760 for calculated value of C2).

h. Repeat steps c through g for the horizontal (right) plug-in compartment. Fig. 5-1a shows the individual capacitances for the horizontal plug-in compartment.

NOTES

SECTION 6
PARTS LIST AND SCHEMATICS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

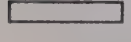
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

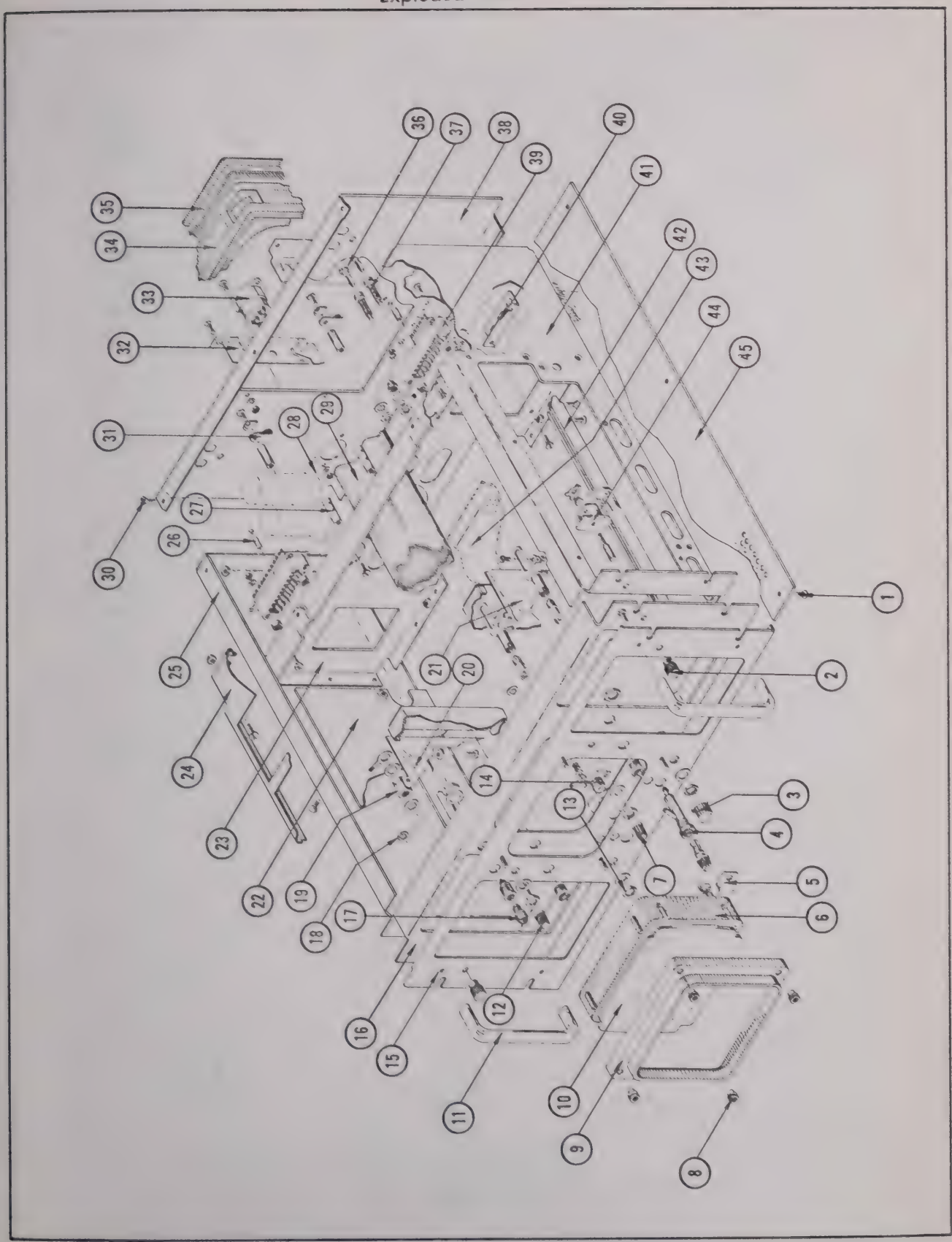
ABBREVIATIONS AND SYMBOLS

a or amp	amperes
BHS	binding head steel
C	carbon
cer	ceramic
cm	centimeter
comp	composition
cps	cycles per second
crt	cathode-ray tube
CSK	counter sunk
dia	diameter
div	division
EMC	electrolytic, metal cased
EMT	electroyltic, metal tubular
ext	external
f	farad
F & I	focus and intensity
FHS	flat head steel
Fil HS	fillister head steel
g or G	giga, or 10^9
Ge	germanium
GMV	guaranteed minimum value
h	henry
hex	hexagonal
HHS	hex head steel
HSS	hex socket steel
HV	high voltage
ID	inside diameter
incd	incandescent
int	internal
k or K	kilohms or kilo (10^3)
kc	kilocycle
m	milli, or 10^{-3}
mc	megacycle
mm	millimeter
meg or M	megohms or mega (10^6)
met.	metal
μ	micro, or 10^{-6}
n	nano, or 10^{-9}
Ω	ohm
OD	outside diameter
OHS	oval head steel
p	pico, or 10^{-12}
PHS	pan head steel
piv	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
Prec	precision
PT	paper tubular
PTM	paper or plastic, tubular, molded
RHS	round head steel
rms	root mean square
sec	second
Si	silicon
S/N	serial number
t or T	tera, or 10^{12}
TD	toroid
THS	truss head steel
tub.	tubular
v or V	volt
Var	variable
w	watt
w/	with
w/o	without
WW	wire-wound

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

Exploded View



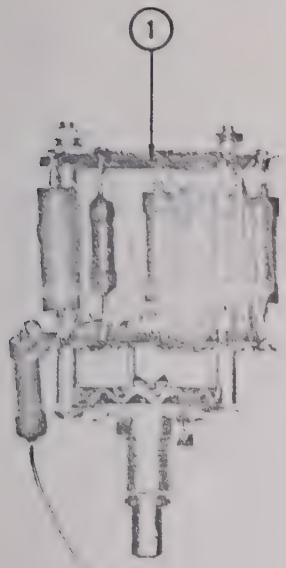
EXPLODED VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	211-0565-00			20	SCREW, 6-32 x 1/4 in. truss HS, phillips slot
2	366-0109-00			2	KNOB, PLUG-IN SECURING
3	366-0113-00	5001	6209	1	KNOB, POWER AND SCALE ILLUM.
	366-0220-00	6210		1	KNOB, POWER AND SCALE ILLUM.
	210-0413-00	5001	6209	1	NUT, hex, brass, 3/8-32 x 1/2 in.
	210-0590-00	6210		1	NUT, hex, brass, 3/8-32 x 7/16 in.
4	352-0014-00			1	HOLDER, fuse, with hardware
	200-0237-00	5001	6279X	1	COVER, insulation, fuse holder, clear
5	352-0049-00	5001	6885	1	HOLDER, reflector shield
	214-0442-00	6886		1	SPRING, light pipe
	337-0540-00	5001	6885	1	SHIELD, reflector
	387-0934-00	6886		1	PLATE, light reflector
6	354-0181-00			1	RING, CRT shockmount, black neoprene
	124-0167-00	X6886		1	STRIP, neoprene
7	366-0153-00			1	KNOB, INTENSITY
	210-0583-00			1	NUT, hex, brass, 1/4-32 x 5/16 in.
	210-0940-00			1	WASHER, steel, 1/4 in.
8	210-0571-00			4	NUT, graticule cover, 3/8 in. alum. 10-32 knurled
9	200-0426-00			1	COVER, trim and graticule assembly
10	337-0539-00			1	SHIELD, implosion, plexiglass
11	367-0032-00			2	HANDLE, nickel plated
	213-0090-00			2	SCREW, 10-32 x 1/2 in. hex
12	366-0153-00			1	KNOB, FOCUS
	210-0583-00			1	NUT, hex, brass, 1/4-32 x 5/16 in.
	210-0940-00			1	WASHER, steel, 1/4 in.
13	366-0113-00			1	KNOB, CALIBRATOR
	210-0413-00			1	NUT, hex, brass, 3/8-32 x 1/2 in.
	210-0840-00			1	WASHER, steel
	210-0013-00			1	LOCKWASHER, steel, internal 3/8 x 11/16 in.
14	131-0064-00	100	5279	1	CONNECTOR, chassis mount. cal. out coax
	131-0279-00	5280		1	CONNECTOR, BNC
					Mounting Hardware: (not included)
	406-0244-00			1	BRACKET, nylon molded, coax insulator
	210-0224-00			1	LUG, solder, #10, non-locking
	210-0812-00			2	WASHER, fiber #10
	210-0004-00			2	LOCKWASHER, steel, internal #4
	210-0406-00			2	NUT, hex, brass, 4-40 x 3/16 in.
	210-0961-00	X5280		1	WASHER, plastic
15	333-0731-00			1	PANEL, front
16	387-0696-00			1	PLATE, subpanel, front
17	136-0031-00			1	SOCKET, light, red, assembly
18	210-0011-00			2	LOCKWASHER, steel, internal 1/4 in.
19	358-0010-00			2	BUSHING, alum. 3/8-32 x 9/16 in.
	210-0013-00			2	LOCKWASHER, steel, internal 3/8 x 11/16 in.
	210-0494-00			2	NUT, hex, alum. 3/8-32 x 1/2 x 11/16 in.
	210-0012-00			2	LOCKWASHER, steel, pot, internal 3/8 x 1/2 in.
	210-0207-00			2	LUG, solder, pot, plain, 3/8 in.
20	337-0536-00			1	SHIELD, Focus and Intensity, left
21	337-0535-00			1	SHIELD, Focus and Intensity, right
22	387-0450-00			1	PLATE, left side cover
	387-0449-00			1	PLATE, right side cover
					Mounting Hardware: (not included)
	211-0504-00			8	SCREW, 6-32 x 1/4 in. BHS
	211-0541-00			8	SCREW, 6-32 x 1/4 in. FHS, 100° CSK, phillips
23	387-0716-00			1	PLATE, bulkhead
					Mounting Hardware: (not included)
	212-0002-00			10	SCREW, 8-32 x 1/4 in. FHS, 100° CSK
	210-0458-00			10	NUT, keps, steel, 8-32 x 11/32 in.
24	406-0716-00			2	BRACKET, plug-in, alum.
					Mounting Hardware: (not included)
	212-0004-00			2	SCREW, 8-32 x 5/16 in. BHS

Exploded View *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
	212-0070-00			2	SCREW, 8-32 x 5/16 in. FHS, phillips
	210-0458-00			4	NUT, keps, steel, 8-32 x 11/32 in.
25	387-0447-00			1	PLATE, side left
26	352-0015-00			2	HOLDER, nylon, for coil form
	213-0045-00			2	SCREW, 4-40 x 5/16 in. Pan Head, phillips
27	385-0113-00			2	ROD, nylon, 5/16 x 1 1/8 in.
	211-0507-00			2	SCREW, 6-32 x 5/16 in BHS
28	Pg. 6-8				Chassis, rear
29	Pg. 6-10				CRT Shield
30	212-0070-00			32	SCREW, 8-32 x 5/16 in. FHS, phillips
	210-0458-00			32	NUT, keps, steel, 8-32 x 11/32 in.
31	385-0013-00			2	ROD, nylon, 5/16 x 3/4 in.
	343-0004-00			2	CLAMP, cable, 5/16 in., plastic
	210-0863-00			2	WASHER, steel, "D" Type for #10 screw
	211-0507-00			4	SCREW, 6-32 x 5/16 in. BHS
32	351-0046-00			2	GUIDE, fan clips
					Mounting Hardware: (not included)
	211-0538-00			2	SCREW, 6-32 x 5/16 in. FHS, 100° CSK, phillips
	210-0006-00			2	LOCKWASHER, steel, internal #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 in.
33	131-0150-00			1	CONNECTOR, chassis mount, 3 wire motor base assembly
	213-0041-00			2	SCREW, 5-32 x 3/16 in. Pan H, phillips
34	119-0013-00	5001	5132	1	BLOWER, fan, assembly
	119-0026-00	5133		1	BLOWER, fan, assembly
35	378-0761-00			1	SCREEN, grille for fan
36	134-0012-00			1	PLUG, plated, banana male, twin
37	136-0139-00			1	SOCKET, banana jack assembly, with red nylon cap
	136-0140-00			1	SOCKET, banana jack assembly, with charcoal nylon cap
	210-0898-00			1	WASHER, insulating, red
	210-0011-00			1	LOCKWASHER, steel, internal 1/4 in.
	210-0223-00			1	LUG, solder, 1/4 in.
	210-0465-00			3	NUT, hex, brass, 1/4-32 x 3/8 in.
38	387-0695-00	5001	6441	1	PLATE, rear
	387-0937-00	6442		1	PLATE, rear
					Mounting Hardware: (not included)
	212-0004-00			4	SCREW, 8-32 x 5/16 in. BHS
	210-0458-00			4	NUT, keps, steel, 8-32 x 11/32 in.
39	131-0148-00			2	CONNECTOR, chassis mount, 24 contact
					Mounting Hardware: (not included)
	211-0014-00			2	SCREW, 4-40 x 1/2 in. BHS
	166-0029-00			2	TUBE, spacer, alum.
	210-0004-00			2	LOCKWASHER, steel, internal #4
	210-0406-00			2	NUT, hex, brass, 4-40 x 3/16 in.
40	406-0893-00			1	BRACKET, pot mounting
					Mounting Hardware: (not included)
	211-0504-00			2	SCREW, 6-32 x 1/4 in. BHS
41	387-0446-00			1	PLATE, side right
42	351-0047-00			2	GUIDE, rail track, alum.
					Mounting Hardware: (not included)
	211-0541-00			2	SCREW, 6-32 x 1/4 in. FHS, 100° CKS, phillips
	210-0407-00			1	NUT, hex, brass, 6-32 x 1/4 in.
43	Pg. 6-6				Chassis, front
44	214-0052-00	5001	6319	1	FASTENER, right, with stop assembly
	214-0424-00	6320		1	FASTENER, right, with stop assembly
	214-0053-00	5001	6319	1	FASTENER, left, with stop assembly
	214-0425-00	6320		1	FASTENER, left, with stop assembly
					Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, steel, internal #4
	210-0406-00			2	NUT, hex, brass, 4-40 x 3/16 in.
45	387-0452-00			2	PLATE, dust cover, top and bottom
					Mounting hardware: (not included)
	211-0565-00			10	SCREW, 6-32 x 1/4 in. truss HS, phillips slot

Switches

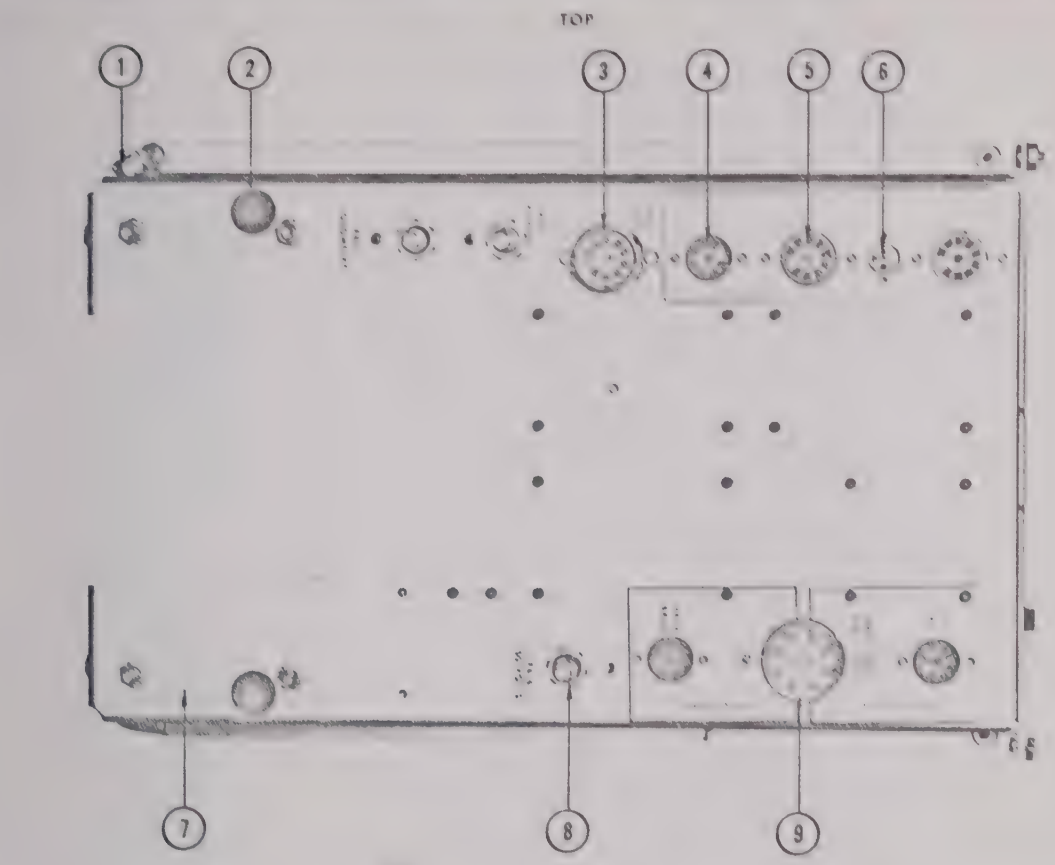


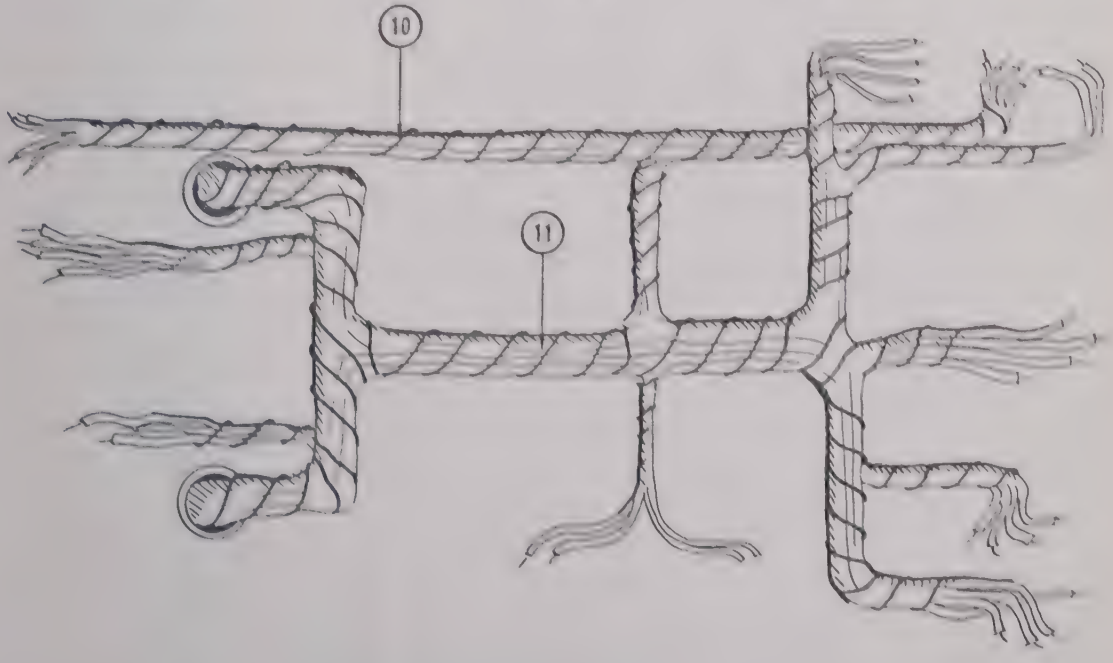
CALIBRATOR

SLIDE SPDT

EFF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	262-515			1	SWITCH, Calibrator, wired
	260-394				SWITCH, Calibrator, unwired
					Mounting Hardware: (not included)
	210-413			1	NUT, hex, brass $^{3}/_{8}$-32 x $^{1}/_{2}$ in.
	210-840			1	WASHER, steel
	210-013			1	LOCKWASHER, steel, internal $^{3}/_{8}$ x $^{11}/_{16}$ in.
2	260-449			1	SWITCH, raw, slide, SPDT
					Mounting Hardware: (not included)
	211-008			2	SCREW, 4-40 x $^{1}/_{4}$ in. BHS
	210-406			2	NUT, hex, brass, 4-40 x $^{3}/_{16}$ in.

Front Chassis & Cable Harness



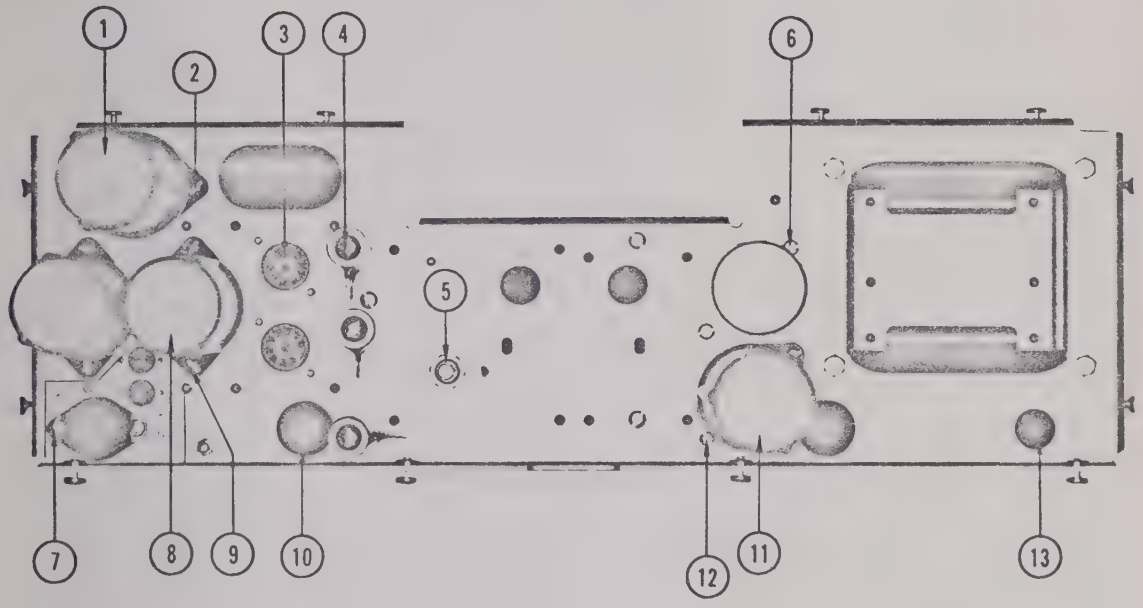


FRONT CHASSIS & CABLE HARNESSES

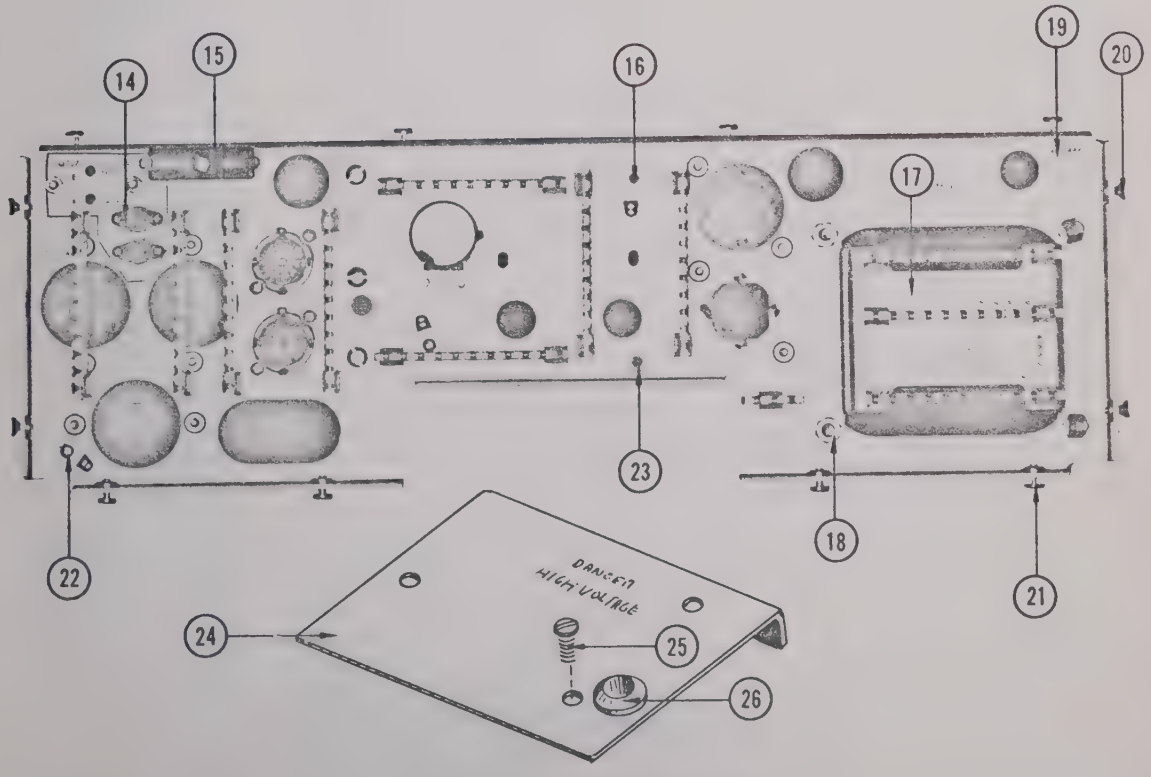
PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
344-0095-00			2	CLIP, grounding
				Mounting Hardware: (not included)
211-0559-00			1	SCREW, steel, 6-32 x 3/8 in. FHS, 100° CSK
210-0803-00			1	WASHER, steel, 6L x 3/8 in.
210-0006-00			1	LOCKWASHER, steel, internal #6
210-0407-00			1	NUT, hex, brass, 6-32 x 1/4 in.
348-0006-00			2	GROMMET, rubber, 3/4 in.
136-0022-00			2	SOCKET, STM9S
				Mounting Hardware: (not included)
211-0033-00			2	SCREW, 4-40 x 5/16 in. Pan HS, with lockwasher
210-0004-00			2	LOCKWASHER, steel internal #4
210-0406-00			2	NUT, hex, brass, 4-40 x 3/16 in.
136-0008-00			3	SOCKET, STM7G
				Mounting Hardware: (not included)
213-0044-00			2	SCREW, 5-32 x 3/16 in. Pan H, thread cutting
136-0015-00			2	SOCKET, STM9G
				Mounting Hardware: (not included)
213-0044-00			2	SCREW, 5-32 x 3/16 in. Pan H, thread cutting
136-0095-00			1	SOCKET, 4 pin, transistor
				Mounting Hardware: (not included)
213-0113-00			2	SCREW, 2-32 x 5/16 in. RHS, thread forming
441-0448-00			1	CHASSIS, front
				Mounting Hardware: (not included)
212-0004-00			6	SCREW, 8-32 x 5/16 in. BHS
212-0070-00			2	SCREW, 8-32 x 5/16 in. FHS, phillips
210-0458-00			4	NUT, keps, steel, 8-32 x 11/32 in.
				Pot Mounting Hardware:
210-0413-00			1	NUT, hex, brass, 3/8-32 x 1/2 in.
210-0840-00			1	WASHER, steel
136-0013-00			1	SOCKET, STM8
				Mounting Hardware: (not included)
211-0538-00			2	SCREW, 6-32 x 5/16 in. FHS, 100° CSK, phillips
210-0006-00			1	LOCKWASHER, steel, internal #6
210-0203-00			1	LUG, solder, SE6, long
210-0407-00			2	NUT, hex, brass, 6-32 x 1/4 in.
179-0699-00	5001	5969	1	CABLE harness
179-0857-00	5970		1	CABLE harness
179-0688-00			1	CABLE harness, chassis

Rear Chassis

TOP



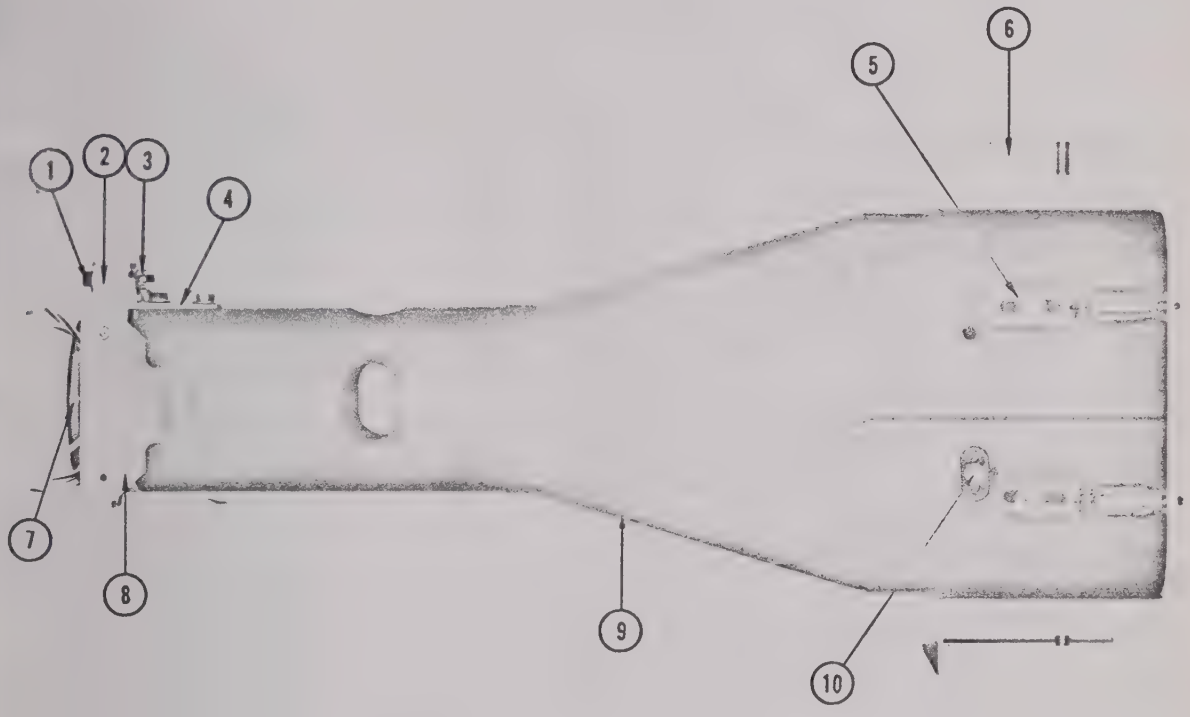
BOTTOM



REAR CHASSIS

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	200-258			1	COVER, capacitor, polyethylene
	386-254			1	PLATE, fiber, large, capacitor mounting
					Mounting Hardware: (not included)
2	211-543			2	SCREW, 6-32 x 5/16 in. RHS
3	136-015			2	SOCKET, STM9G
					Mounting Hardware: (not included)
	213-044			2	SCREW, thread cutting, 5-32 x 3/16 in. Pan H phillips
4					Resistor Mounting Hardware:
	212-037			3	SCREW, 8-32 x 1 3/4 in. Fil HS
	210-808			3	WASHER, brass, centering resistor
	210-462			3	NUT, hex, alum. 8-32 x 1/2 in.
	212-004			3	SCREW, 8-32 x 5/16 in. BHS
5					Pot Mounting Hardware:
	210-413			1	NUT, hex, brass, 3/8-32 x 1/2 in.
	210-840			1	WASHER, steel
6	386-255			1	PLATE, metal large, capacitor mounting
					Mounting Hardware: (not included)
	211-534			2	SCREW, 6-32 x 5/16 in. PHS, with lockwasher
7					Transistor Mounting Hardware:
	211-510			2	SCREW, 6-32 x 3/8 in. BHS
	210-006			1	LOCKWASHER, steel, internal #6
	210-407			2	NUT, hex, brass, 6-32 x 1/4 in.
8	200-293			2	COVER, capacitor, polyethylene
	386-254			3	PLATE, fiber, large, capacitor mounting
9	211-543			4	SCREW, (capacitor assembly) 6-32 x 5/16 in. RHS
10	348-006			2	GROMMET, rubber, 3/4 in.
11	200-259			1	COVER, capacitor, polyethylene
	432-044			1	BASE, capacitor mounting
	386-254			1	PLATE, fiber, large, capacitor mounting
					Mounting Hardware: (not included)
12	211-532			2	SCREW, 6-32 x 3/4 in. HS Fil
13	348-005			5	GROMMET, rubber, 1/2 in.
14	136-095			2	SOCKET, 4 pin, transistor
					Mounting Hardware: (not included)
	213-113			2	SCREW, 2-32 x 5/16 in. RHS, phillips, thread forming
15	352-031			1	HOLDER, fuse, single, 3AG
					Mounting Hardware: (not included)
	211-510			1	SCREW, 6-32 x 3/8 in. BHS
	210-006			1	LOCKWASHER, steel, internal #6
	210-407			1	NUT, hex, brass, 6-32 x 1/4 in.
16	166-099			2	TUBE, spacer, alum. 1/4 x 1-23/32 in.
					Mounting Hardware: (not included)
	211-507			1	SCREW, 6-32 x 5/16 in. BHS
	210-202			1	LUG, solder, SE6
17	406-617			1	BRACKET, transformer strip mounting
					Mounting Hardware: (not included)
18	210-564			4	NUT, 10-32 x 3/8 in.
	210-010			4	LOCKWASHER, steel, internal #10
19	441-449			1	CHASSIS, rear
					Mounting Hardware: (not included)
20	212-070			4	SCREW, 8-32 x 5/16 in. FHS
21	212-004			8	SCREW, 8-32 x 5/16 in. BHS
22	210-201			2	LUG, solder, SE4
	213-044			2	SCREW, thread cutting, 5-32 x 3/16 in. Pan H
23	385-060			2	ROD, nylon, 5/16 dia. x 1 3/4 in.
	211-507			2	SCREW, 6-32 x 5/16 in. BHS
24	337-534			1	SHIELD, H. V. Power
					Mounting Hardware: (not included)
25	211-507			3	SCREW, 6-32 x 5/16 in. BHS
26	348-005			1	GROMMET, rubber, 1/2 in.

CRT SHIELD

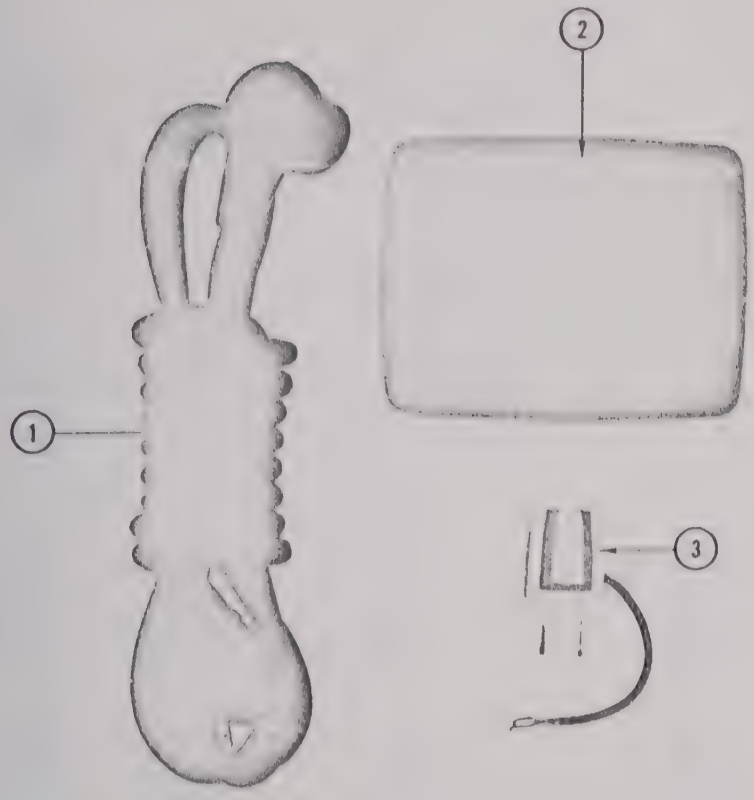


REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	211-0576-00			2	SCREW, 6-32 x 7/8 in. socket head cap, black finish
	210-0949-00			2	WASHER, brass, 1/2 in.
2	354-0147-00	5001	5489	1	RING, clamping, delrin, 1/2 x 2 1/4 in.
	354-0212-00	5490		1	RING, clamping, delrin
	211-0560-00			1	SCREW, 6-32 x 1 in. RHS
	210-0419-00			1	NUT, hex, brass, 6-32 x 1/4 in.
3	214-0411-00			1	NUT, adj. securing
4	406-0993-00			1	BRACKET, parallax adj. zinc plated
					Mounting Hardware: (not included)
	211-0534-00			4	SCREW, 6-32 x 5/16 in. PHS, withlockwasher
	210-0803-00			4	WASHER, steel, 6L x 3/8 in.
	210-0006-00			4	LOCKWASHER, steel, internal #6
	210-0407-00			4	NUT, hex, brass, 6-32 x 1/4 in.

CRT SHIELD

EFF. O.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
5	136-0035-00			2	SOCKET, graticule light, with ground lug
					Mounting Hardware: (not included)
	211-0534-00			1	SCREW, 6-32 x 5/16 in. PHS, with lockwasher
	210-0803-00			3	WASHER, steel, 6L x 3/8 in.
	210-0006-00			1	LOCKWASHER, steel internal #6
	210-0407-00			1	NUT, hex, brass, 6-32 x 1/4 in.
6	406-0847-00			1	BRACKET, CRT Shield, left
	406-0846-00			1	BRACKET, CRT Shield, right
					Mounting Hardware: (not included)
	212-0004-00			2	SCREW, 8-32 x 5/16 in. BHS
	212-0070-00			1	SCREW, 8-32 x 5/16 in. FHS, phillips
	210-0458-00			3	NUT, keps, steel, 8-32 x 11/32 in.
	211-0534-00			2	SCREW, 6-32 x 5/16 in. PHS, with lockwasher
	210-0006-00			2	LOCKWASHER, steel, internal #6
	210-0407-00			2	NUT, hex, brass, 6-32 x 1/4 in.
7	136-0136-00	5001	5729	1	SOCKET, CRT assembly
	136-0177-00	5730		1	SOCKET, CRT assembly
					Consisting of:
	131-0178-00			9	CONNECTOR, cable end
	136-0117-00			1	SOCKET, CRT 14 pin
	210-0849-00			2	WASHER, fiber #4, shoulder
	210-0850-00			2	WASHER, steel, #2, flat
	213-0116-00			2	SCREW, thread, cutting, #2 x 9/16 in., steel
	337-0456-00			1	SHIELD, CRT socket
	387-0393-00			1	PLATE, back, CRT socket
8	406-0867-00			1	BRACKET, CRT mounting
					Mounting Hardware: (not included)
	211-0504-00			1	SCREW, 6-32 x 1/4 in. BHS
	211-0507-00			2	SCREW, 6-32 x 5/16 in. BHS
	210-0803-00			2	WASHER, steel, 6L x 3/8 in.
9	337-0530-00			1	SHIELD, CRT
10	352-0044-00			1	HOLDER, form coil, CRT polypropylene, black
	211-0011-00			1	SCREW, 4-40 x 5/16 in. BHS
	211-0004-00			1	LOCKWASHER, steel, internal #4
	210-0406-00			1	NUT, hex, brass, 4-40 x 3/16 in.

ACCESSORIES



REF. NO.	PART NO	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	161-013	101	7499	1	CORD, power, 18 gauge, 8 ft.
	161-022	7500		1	CORD, power, 18 gauge, 8 ft.
2	378-534			1	FILTER, light, green plexiglas
3	103-013			1	ADAPTER, power cord, 3 wire to 2 wire

ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description			S/N Range
		Bulbs			
B601	150-001	Incandescent, G.E. #47, Graticule Light			
B602	150-001	Incandescent, G.E. #47, Graticule Light			
B603	150-004	Incandescent, G.E. #328, Pilot Light			
B856	150-025	Neon, NE-2E			
B857	150-025	Neon, NE-2E			
		Capacitors			
Tolerance ±20% unless otherwise indicated.					
Tolerance of all electrolytic capacitors are as follows (with exceptions):					
3 V — 50 V = −10%, +250%					
51 V — 350 V = −10%, +100%					
351 V — 450 V = −10%, +50%					
C611	285-510	.01 μf	MT		400 v
C616	285-510	.01 μf	MT		400 v
C640A,B	Use *290-224	340 μf x 10 μf	EMC		250 v
C642A,B	*290-224	340 μf x 10 μf	EMC		250 v
C644	*290-244	340 μf x 10 μf	EMC		250 v
C650	285-510	.01 μf	MT		400 v
C667	290-002	8 μf	EMT		450 v
C670	285-510	.01 μf	MT		400 v
C720A	*290-086	2000 μf	EMC		30 v
C720B	*290-086	2000 μf	EMC		30 v
C732	Use 290-201	100 μf	EMT		15 v
C737	283-026	.2 μf	Disc Type		25 v
C757	Use 290-231	100 μf	EMT		25 v
C760	281-027	.7-3 pf	Tub.	Var.	
C761	281-027	.7-3 pf	Tub.	Var.	
C801	283-006	.02 μf	Disc Type		600 v
C803	283-000	.001 μf	Disc Type		500 v
C807	285-502	.001 μf	MT		1000 v
C822	283-071	.0068 μf	Disc Type		5000 v
C830	283-036	.0025 μf	Disc Type		6000 v
C832	283-036	.0025 μf	Disc Type		6000 v
C837	283-036	.0025 μf	Disc Type		6000 v
C841	285-519	.047 μf	MT		400 v
C842	283-071	.0068 μf	Disc Type		5000 v
C853	283-036	.0025 μf	Disc Type		6000 v
C876	290-025	6.25 μf	EMT		300 v
C878	281-523	100 pf	Cer.		350 v
C884	281-524	150 pf	Cer.		500 v

©

Diodes

kt. No.	Tektronix Part No.	Description	S/N Range
640A,B,C,D	*152-047	Silicon Replaceable by 1N2862	
642A,B,C,D	*152-047	Silicon Replaceable by 1N2862	
644A,B,C,D	*152-047	Silicon Replaceable by 1N2862	
720	152-035	Silicon 1N1563A	
721	152-035	Silicon 1N1563A	
838	*152-047	Silicon Replaceable by 1N2862	
839	*152-047	Silicon Replaceable by 1N2862	

Fuses

601	159-005	3 Amp 3AG Slo-Blo 117 v oper. 50 & 60 cycle	
601	159-041	1.25 AMP 3AG Slo-Blo 234 v oper. 50 & 60 cycle	
720	159-023	2 Amp 3AG Slo-Blo	

Inductors

860	Use *108-285	Beam Rotator	

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R601†	311-340	50 Ω		Var.		SCALE ILLUM.
R602	308-142	30 Ω	3 w		WW	5%
R603	304-330	33 Ω	1 w			
R609	302-106	10 meg	½ w			
R610	302-104	100 k	½ w			
R611	302-102	1 k	½ w			
R612	302-272	2.7 k	½ w			
R616	311-015	10 k		Var.	WW	—100 VOLTS
R617	308-186	80 k	½ w		WW	1%
R618	308-226	10 k	½ w		WW	1%
R619	302-224	220 k	½ w			
R624	302-473	47 k	½ w			
R625	302-222	2.2 k	½ w			
R626	302-184	180 k	½ w			
R627	302-102	1 k	½ w			
R628	308-176	4 k	20 w		WW	5%
R632	302-102	1 k	½ w			
R633	302-473	47 k	½ w			
R635	301-302	3 k	½ w			5%
R640	304-100	10 Ω	1 w			

† Concentric with SW601. Furnished as a unit.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description				S/N Range
R642	304-100	10 Ω	1 w				
R644	304-100	10 Ω	1 w				
R650	309-101	330 k	½ w		Prec.	1%	
R651	309-162	250 k	½ w		Prec.	1%	
R652	302-102	1 k	½ w				
R653	302-225	2.2 meg	½ w				
R654	302-474	470 k	½ w				
R655	302-685	6.8 meg	½ w				
R656	311-068	500 k	.2 w	Var.		+125 VOLTS	
R657	302-684	680 k	½ w				
R658	302-273	27 k	½ w				
R659	302-333	33 k	½ w				
R663	302-102	1 k	½ w				
R664	302-102	1 k	½ w				
R666	308-176	4 k	20 w		WW	5%	
R667	308-176	4 k	20 w		WW	5%	
R670	309-156	1.024 meg	½ w		Prec.	1%	
R671	309-053	333 k	½ w		Prec.	1%	
R672	302-102	1 k	½ w				
R673	302-105	1 meg	½ w				
R675	302-825	8.2 meg	½ w				
R676	311-068	500 k	.2 w	Var.		+300 VOLTS	
R677	304-224	220 k	1 w				
R678	302-394	390 k	½ w				
R679	302-333	33 k	½ w				
R729	302-823	82 k	½ w				X5160-up
R730	311-068	500 k	.2 w	Var.		−12.2 VOLTS	
R731	309-104	2.05 k	½ w		Prec.	1%	
R732	310-115	15 k	1 w		Prec.	1%	
R733	302-564	560 k	½ w				5001-5159
R733	301-394	390 k	½ w			5%	5160-up
R734	302-334	330 k	½ w				
R735	302-272	2.7 k	½ w				
R737	302-151	150 Ω	½ w				
R744	308-231	220 Ω	3 w		WW	5%	
R754	302-471	470 Ω	½ w				
R759	302-104	100 k	½ w				
R770	302-564	560 k	½ w				
R781	316-470	47 Ω	¼ w				
R782	316-470	47 Ω	¼ w				
R783	316-470	47 Ω	¼ w				
R784	316-470	47 Ω	¼ w				
R801	306-681	680 Ω	2 w				
R802	302-562	5.6 k	½ w				
R803	306-273	27 k	2 w				
R806	302-104	100 k	½ w				
R807	302-472	4.7 k	½ w				

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description				S/N Range
R813	302-101	100 Ω	½ w			
R815	302-474	470 k	½ w			
R816	302-102	1 k	½ w			
R831	302-104	100 k	½ w			
R832	302-106	10 meg	½ w			
R833	311-349	2 meg		Var.	INTENSITY	
R834	302-105	1 meg	½ w			
R835	Use *050-115	Replacement Kit				5001-5609
R835†	(3) 306-565	5.6 meg	2 w			5610-up
	(2) 306-685	6.8 meg	2 w			
R836	302-223	22 k	½ w			
R837	302-471	470 Ω	½ w			
R838	301-242	2.4 k	½ w		5%	
R839	302-104	100 k	½ w			
R840	301-125	1.2 meg	½ w		5%	
R841	311-042	2 meg		Var.	HIGH VOLTAGE	
R842	Use *050-147	Replacement Kit				5001-5609
R842††	(3) 306-395	3.9 meg	2 w			5610-up
R844	311-254	5 meg	.2 w	Var.	FOCUS	
R846	304-225	2.2 meg	1 w			
R849	302-223	22 k	½ w			
R851	302-104	100 k	½ w			
R852	302-273	27 k	½ w			
R853	302-471	470 Ω	½ w			
R854	302-105	1 meg	½ w			
R860	311-007	2 x 1 k		Var.	ALIGNMENT	
R861	302-680	68 Ω	½ w			
R862	302-823	82 k	½ w			
R863	302-823	82 k	½ w			
R864	311-206	250 k		Var.	ASTIGMATISM	
R865	311-026	100 k		Var.	GEOMETRY	
R870	301-393	39 k	½ w		5%	
R871	311-315	20 k		Var.	CAL. AMPL.	
R872	301-154	150 k	½ w		5%	
R873	302-103	10 k	½ w			
R876	301-153	15 k	½ w		5%	
R877	301-183	18 k	½ w		5%	
R878	301-564	560 k	½ w		5%	
R879	Use 301-114	110 k	½ w		5%	
R883	305-223	22 k	2 w		5%	
R885	310-066	18 k	1 w	Prec.	1%	
R886	309-030	1.8 k	½ w	Prec.	1%	
R887	309-072	180 Ω	½ w	Prec.	1%	
R888	309-064	20 Ω	½ w	Prec.	1%	
R890	309-030	1.8 k	½ w	Prec.	1%	
R891	309-072	180 Ω	½ w	Prec.	1%	
R892	309-064	20 Ω	½ w	Prec.	1%	
R898	309-178	250 Ω	½ w	Prec.	1%	
R899	*308-090	¼ Ω	1 w	WW	1%	

† S/N 5610-up *050-115 may be used
†† S/N 5610-up *050-147 may be used

©

Switches

Ckt. No.	Tektronix Part No. Unwired	Wired		Description	S/N Range
SW601†	311-340			POWER ON-OFF	
SW854	260-447		Slide	CRT CATHODE SELECTOR	
SW870	260-394	*262-515	Rotary	CALIBRATOR	

† Concentric with R601. Furnished as a unit.

Thermal Cutouts

TK601	260-246	Thermal Cutout 123°

Transformers

T601	*120-280	L.V. Power
T801	*120-297	H.V. Power

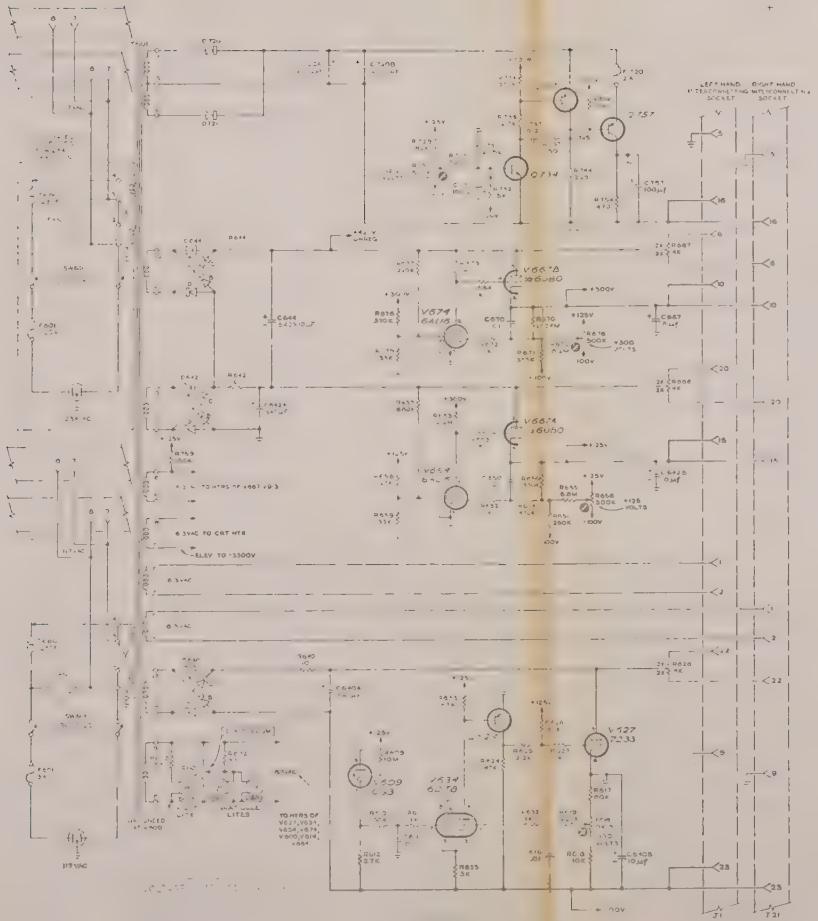
Transistors

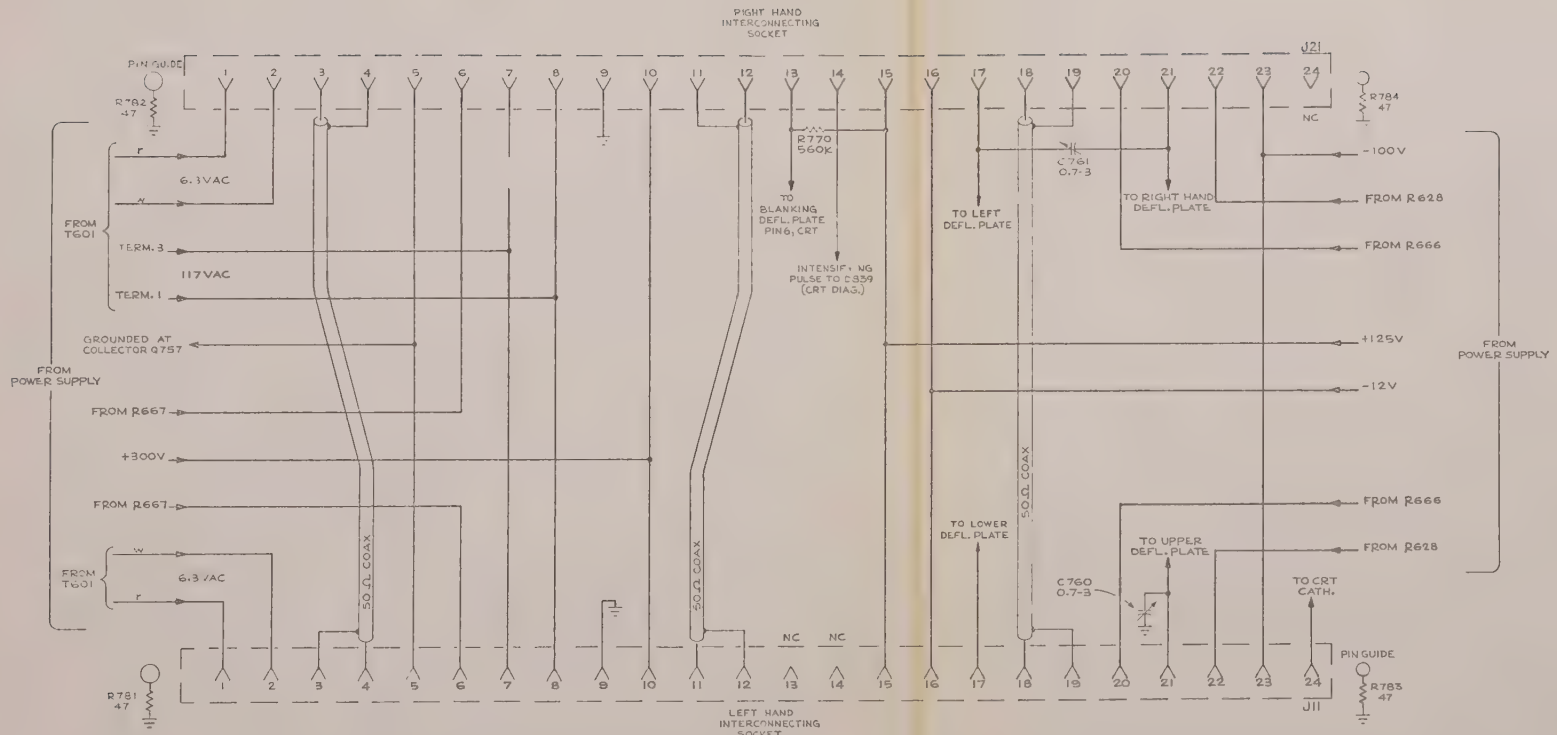
Q624	*151-087	Selected from 2N1131
Q734	151-040	2N1302
Q744	151-042	2N1378
Q757	151-046	2N1529

Electron Tubes

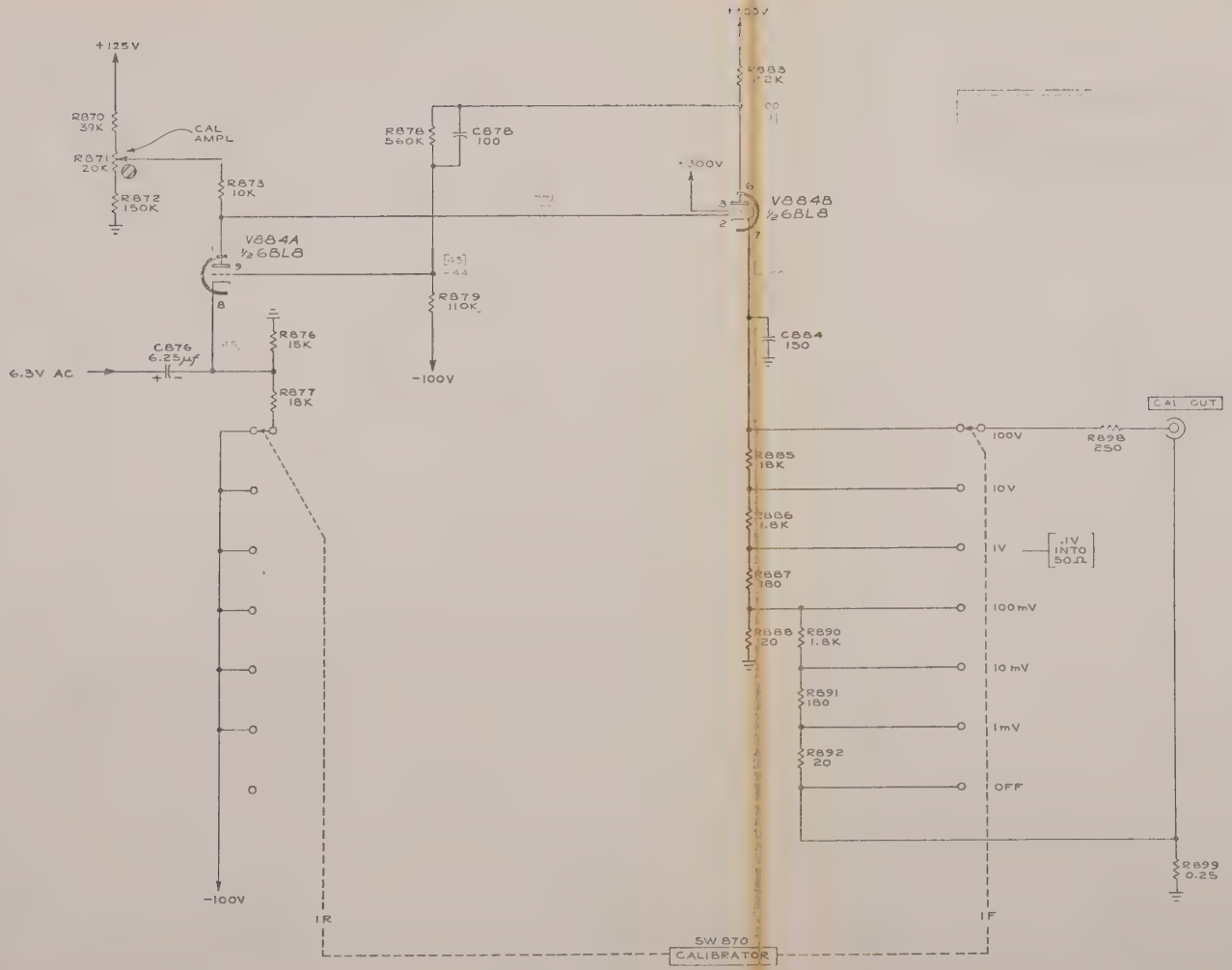
V609	154-291	0G3	
V627	154-307	7233	
V634	154-187	6DJ8	
V654	154-022	6AU6	
V667	154-056	6080	
V674	154-022	6AU6	
V800	154-167	6CZ5	
V814	154-046	12BH7	
V822	154-051	5642	
V832	154-051	5642	
V859†	*154-449	T5032-31-1 CRT Standard Phosphor	5001-6885
V859	*154-449	T5032-31-1 CRT Standard Phosphor	6886-up
V884	154-278	6BL8	

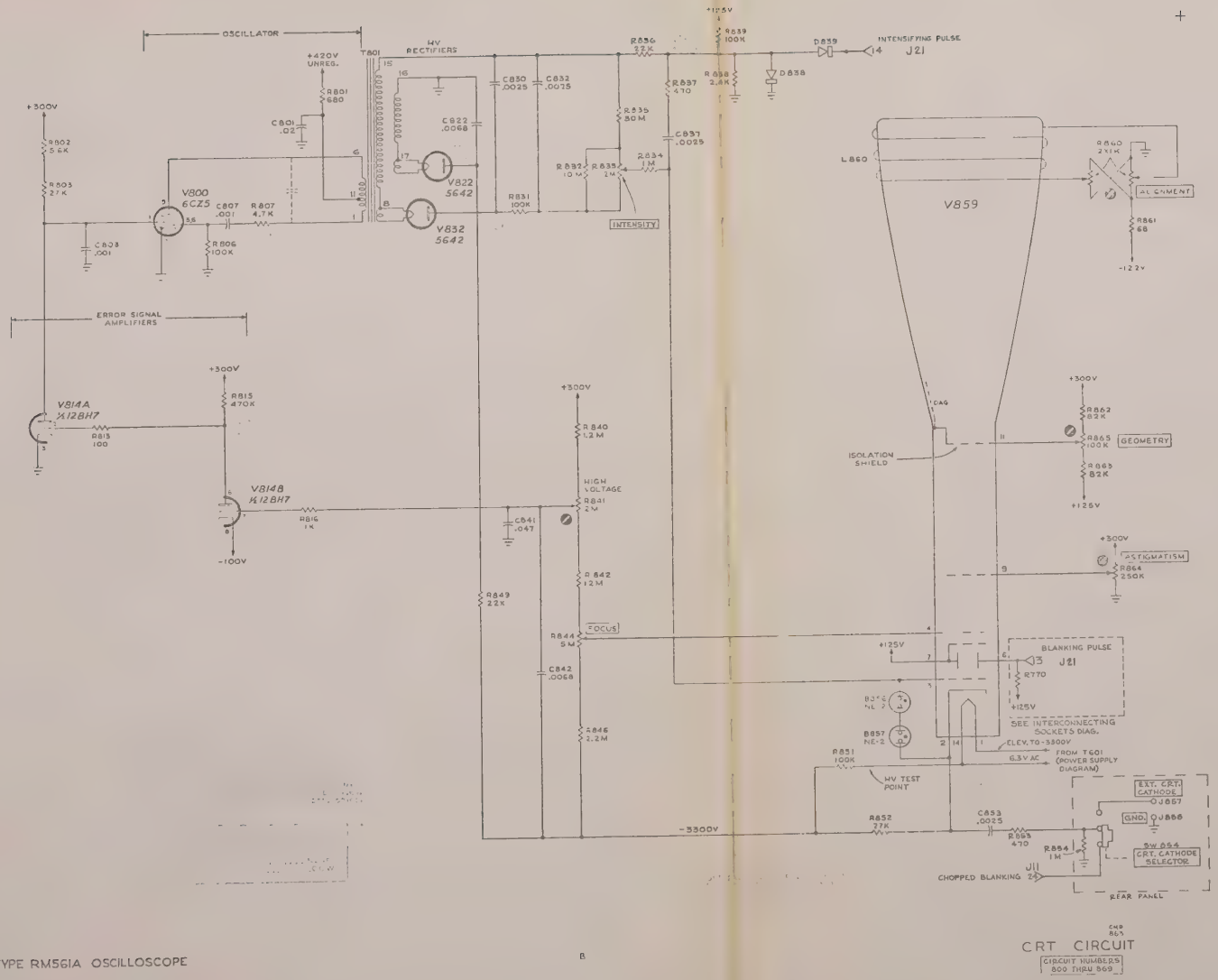
†S/N 5001-6865 add *050-214.


V757
V714
V667B
6SU8C
V674
6AU6
V667A
6SU8
V654
6AU6
V209
6X3
V634
6DJ8
V127
7233
+300V
+125V
+25V
-100V
6.3VAC TO CRT HTR
-1115V TO -3300V
TO HTRS OF V667 V674
TO HTRS OF V634 V209
TO HTRS OF V667,V674, V654, V634, V209, V127, V900, V914
+664
SNAP LIGHT LITES
LEFT HAND
RIGHT HAND
SOCKET
SOCKET
TYPE RM 561A OSCILLOSCOPE
POWER SUPPLY



661
TR
INTERCONNECTING SOCKETS


+125V
R870 39K
CAL AMPL
R871 20K
R872 150K
R873 10K
R878 560K
C878 100
+300V
R883 1.2K
V884B ½6BL8
V884A ½6BL8
R879 110K
-100V
C884 150
C876 6.25μf
6.3V AC
R876 15K
R877 18K
-100V
CAL OUT
100V
R898 250
R885 18K
10V
R886 1.8K
1V
.1V INTO 50Ω
R887 180
100mV
R888 20
R890 1.8K
10 mV
R891 180
1mV
R892 20
OFF
R899 0.25
1R
1F
SW 870
CALIBRATOR



CRT CIRCUIT

CIRCUIT NUMBERS 800 THRU 869

RACKMOUNTING

eneral Information

This instrument is designed to fit most 19-inch wide cks with EIA standard dimensions. The instrument front nel requires at least a 7-inch high mounting space.

The last foldout page is a dimensional drawing of the strument. Any plug-in units, probes, or other accessories at may be used with this instrument are not shown.

etermining the Mounting Method

Use Method 1 if the instrument is to be mounted directly the front rail of the rack as shown in Fig 2. Use Method if the instrument is to be mounted in the rack with slide-t tracks, and the rack has both front and rear rails (see g. 3). Use Method 3 for racks that have only a front rail do not have the proper dimensions between front and ar rails (see Fig. 4).

Enough space should be provided between the rear of e instrument and any obstruction at the rear of the rack allow for proper air circulation and power cord clear-ce. At least 60 cu. ft. of air per minute at a temperature ss than 50°C should pass through the instrument.

The mounting method will determine the effective panel ickness of the instrument. If the instrument is bolted di-ctly to the rack (Method 1) effective panel thickness will $\frac{7}{32}$". When slideout tracks are used, the surface of e instrument panel may be as little as $\frac{7}{32}$" from the rack-ounting surface, or as much as $\frac{5}{16}$", depending on the pe of screws used and whether the front flanges of the deout tracks are mounted behind the front rail (Fig. 9c) in front of it (Fig. 8c). For minimum effective panel thick-ss, countersink flat-head screws into the front rail of the ck. However, this should not be attempted with racks ving thin sheet metal mounting rails.

NOTE

If slideout tracks are used (mounting Methods 2 and 3), the opening between the front rails of the rack must be at least 17⅜" for a rack in which the front flange of the slideout-track stationary section is mounted behind the front rail as shown in Fig. 9c; at least 17¾" if the flange is mounted in front of the front rail as shown in Fig. 8c; or at least 17$\frac{13}{16}$" if the instrument is mounted in a cradle assembly as shown in Fig. 4.

ethod 1—Direct Rackmounting

This type of mounting is intended for instruments which e not equipped with slideout tracks. The front panel of e instrument has two notches on each side so the instru-ent can be mounted directly to the front rail of the rack. ont-panel dimensions and notch locations are shown on e Dimensional Drawing. When mounted in this manner, e rear of the instrument does not need support unless bjected to shock or vibration. Braces can be added at e rear of the instrument if more support is needed.

To mount the instrument directly to the front rails of the ck (see Fig. 2) proceed as follows:

1. Select four oval-head screws (10-32 or 12-24) that match the tapped holes in the rack front rail from the hardware kit. If the holes in the front rail are not tapped, nuts, washers, and longer screws must be used.
2. First, place a cup washer and then a plastic washer on each screw. The plastic washers will protect the instrument front panel.
3. Hold the instrument in the desired position in the rack and fasten securely to the front rail with the oval-head screws.

Method 2—Rackmounting With Slideout Tracks

An instrument which has slideout tracks (optional item) can be mounted in a rack which has a rear support rail to which the reversible rear support bracket can be attached. Mounted in this manner, the instrument is locked into the rack with the two RELEASE knobs on the front panel. When the instrument is released from the rack, it can be pulled out to the fully extended position (see Fig. 3) and then tilted up or down and locked in one of six positions: 45°, 90°, and 105° above or below horizontal. These positions permit most routine maintenance and calibration functions to be performed without removing the instrument from the rack.

The slideout tracks consist of two assemblies: one for the right and one for the left side. Each assembly consists of three sections as illustrated in Fig. 1. The stationary section attaches to the front and rear rails of the rack and the chassis section attaches to the instrument. The intermediate section fits between the stationary and chassis sections and allows the instrument to be extended out of the rack.

The small-hardware components included with the slideout tracks are shown in Figs. 5 and 6. The hardware shown in Fig. 5 is used to mount the stationary sections to the rack. The hardware shown in Fig. 6 is used to mount the chassis sections to the instrument. Since the hardware included is intended to make the slideout tracks compatible to a variety of racks, there will be more parts than needed for this installation. Use only the necessary hardware as described in the following procedures.

Chassis Section Installation—Use the following procedure to attach the chassis sections if they are not already installed. See Fig. 6 for installation details.

1. Remove the plug-in units (if any) from their compartments.
2. Remove the bottom dust cover from the instrument.
3. Remove the nut, lockwasher, and flat washer from the eccentric pivot screw on the chassis section. Hold the chassis section parts, including the pivot screw, so the assembly does not fall apart.
4. Mount the assembly so the pivot screw goes into the hole provided and the detent bar assembly is aligned with the prepunched holes on the side of the instrument.
5. Replace the hardware removed in step 3. Do not tighten the nut.

6. Fasten the detent bar assembly to the instrument side using six 8-32 BHS screws. Align the detent bar so it is parallel with the bottom of the instrument before tightening the screws.

7. Turn the pivot screw until the outer slide is parallel to the bottom of the instrument. Hold the screw in this position and tighten the nut.

8. Make sure the detent release knob is screwed tightly into the detent bar.

Stationary Section Installation—The stationary and intermediate sections of the slideout tracks are shipped as matched sets and should not be separated. The assembly for the right side of the rack is shown in Fig. 1. Use the following procedure to mount both sets. Installation details are shown in Figs. 7, 8, and 9.

1. If the instrument is to be mounted directly above or below another instrument in the rack, select the proper front-rail mounting holes using the measurements shown in Fig. 7.

2. If the mounting holes are tapped for 10-32 screws, the left stationary section can be mounted in front of the rail as shown in Fig. 8c provided the distance between the front rails is a minimum of 17¾". Mount the rear support as shown in Figs. 8a or 8b. Using Fig. 8 as a guide, mount the right stationary section. (Note: If the mounting holes are tapped but the distance between the front rails is less than specified, the mounting holes should be drilled out and the stationary section mounted as described in the following step.)

3. If the mounting holes are not tapped for 10-32 screws, mount the left stationary section behind the front rail as shown in Fig. 9c. Mount the rear support as shown in Figs. 9a or 9b. Using Fig. 9 as a guide, mount the right stationary section.

Instrument Installation—Before installing the instrument, check the alignment of the chassis sections as shown in Fig. 12. Be sure the outer slides are parallel with each other. To install the instrument in the rack, follow the step-by-step procedure given in Fig. 10.

Adjustments—To adjust the slideout tracks for best operation, use the following procedure:

1. Position the instrument in the rack as shown in Fig. 11. Follow the adjustment procedure given in Fig. 11 to horizontally center the instrument in the rack. To center the instrument vertically, use the same procedure but move the instrument up or down for proper spacing.

2. If the instrument does not slide smoothly (even after the centering adjustment), pull the instrument out of the rack and loosen the screws that hold the rear brackets to the rear rail. Push the instrument completely into the rack and tighten the screws.

Method 3—Rackmounting With a Cradle Assembly

A cradle assembly (optional) can be used to mount the instrument in a rack which has only a front rail or does not not have the proper dimensions between the front and rear rails. The cradle assembly provides a rear support for the slideout tracks without affecting their operation. Additional bracing should be added to the rear of the cradle assembly if severe vibration or shock is anticipated.

Mounting instructions for this type of installation are included with the cradle assembly. The cradle assembly can be ordered from your Tektronix Field Office or representative.

Maintenance

The slideout tracks require no lubrication. The special finish on the sliding surfaces provides permanent lubrication.

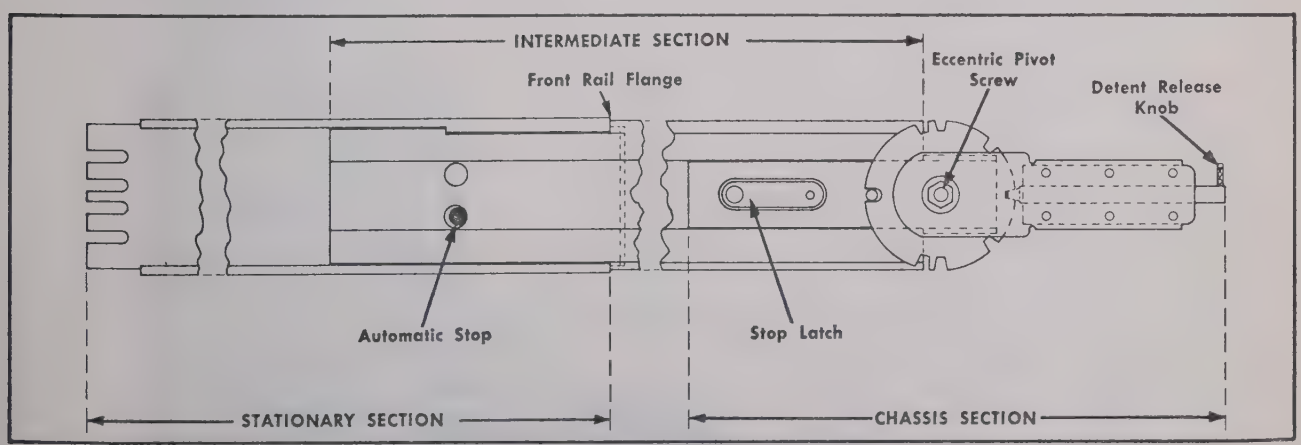


Fig. 1. Slideout track assembly for right side.

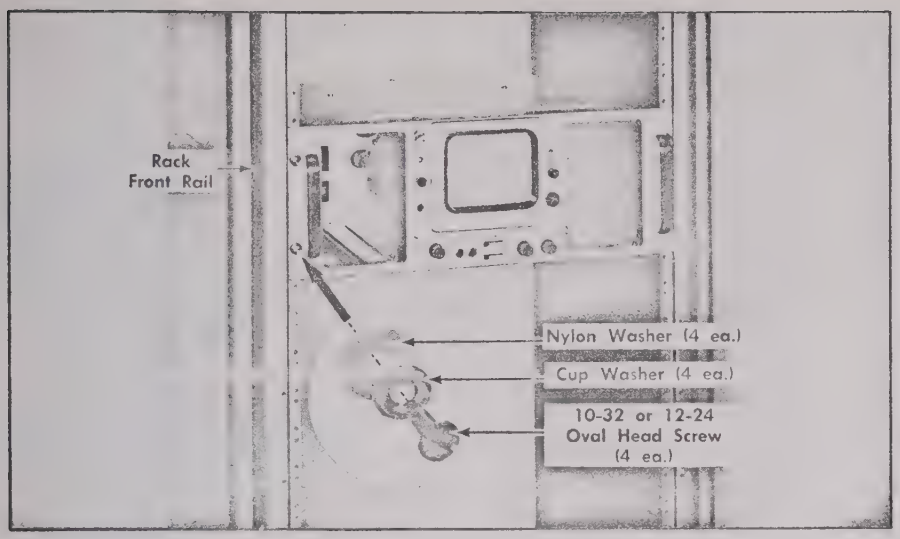


Fig. 2. The instrument mounted directly to the front rail (Method 1).

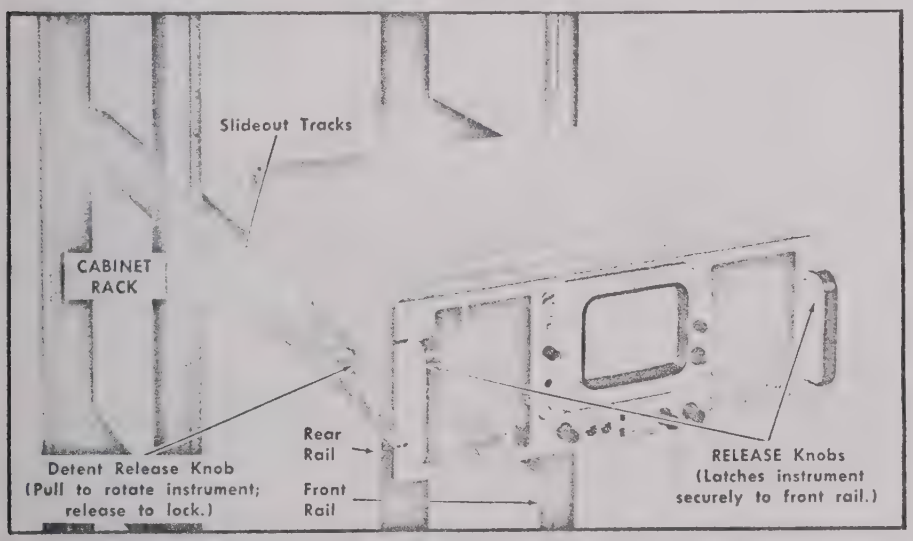


Fig. 3. The instrument mounted with slideout tracks, supported at front and rear (Method 2).

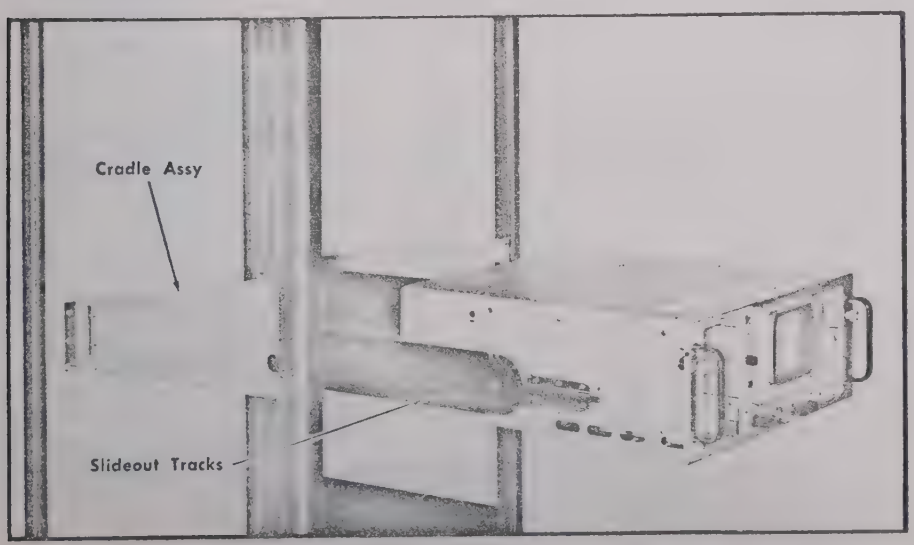


Fig. 4. The instrument mounted with a cradle assembly to support the rear (Method 3).

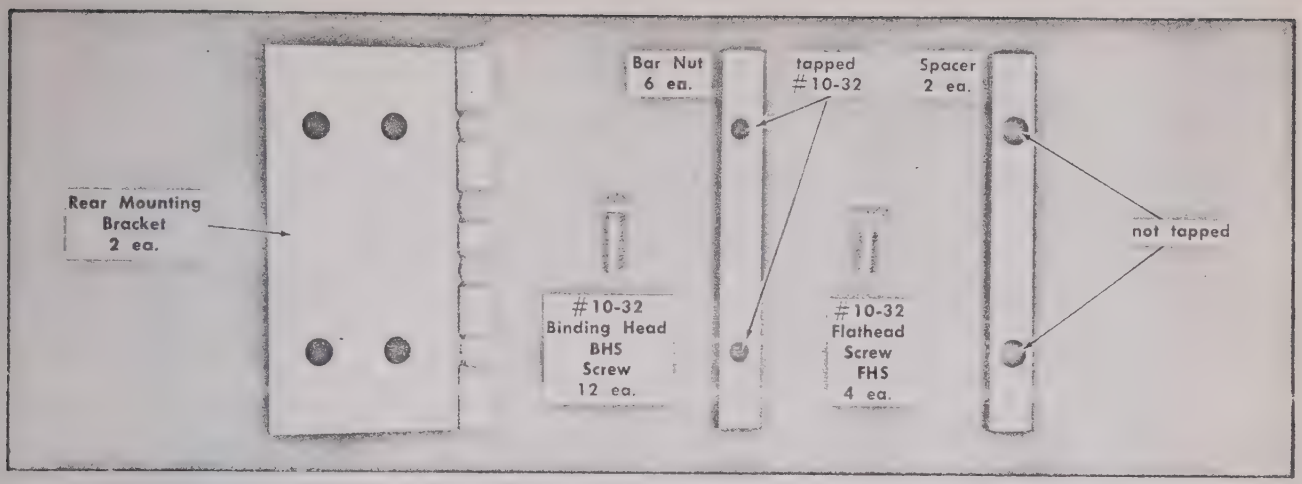

Rear Mounting Bracket 2 ea.
Bar Nut 6 ea.
tapped #10-32
Spacer 2 ea.
not tapped
#10-32 Binding Head BHS Screw 12 ea.
#10-32 Flathead Screw FHS 4 ea.

Fig. 5. Small hardware components for mounting the stationary sections to the rack rails.

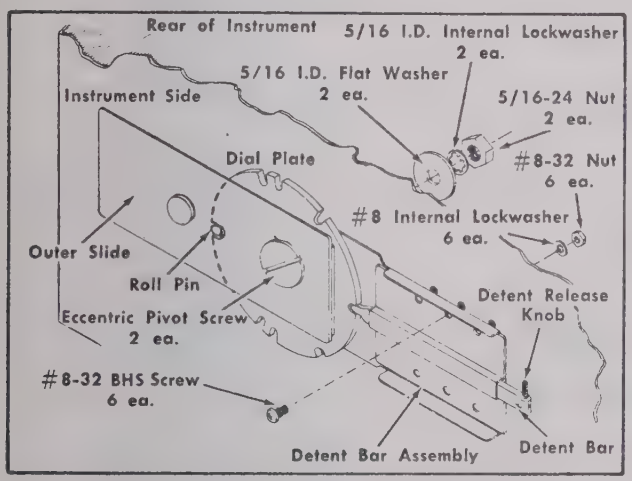


Fig. 6. Details for mounting the left chassis section to the instrument.

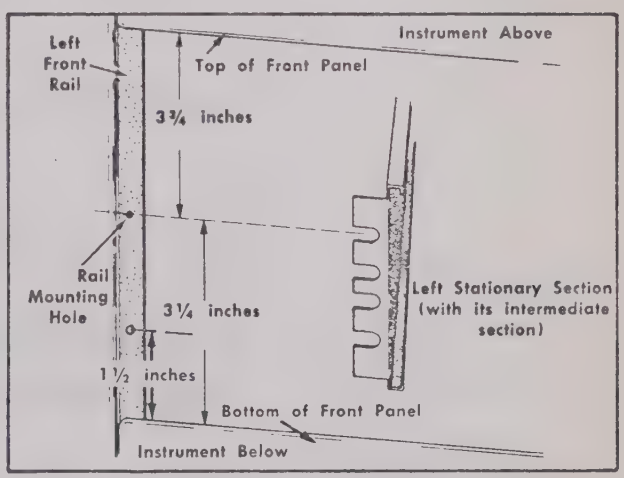


Fig. 7. Vertical mounting position of left stationary section. The same dimensions apply to the right stationary section.

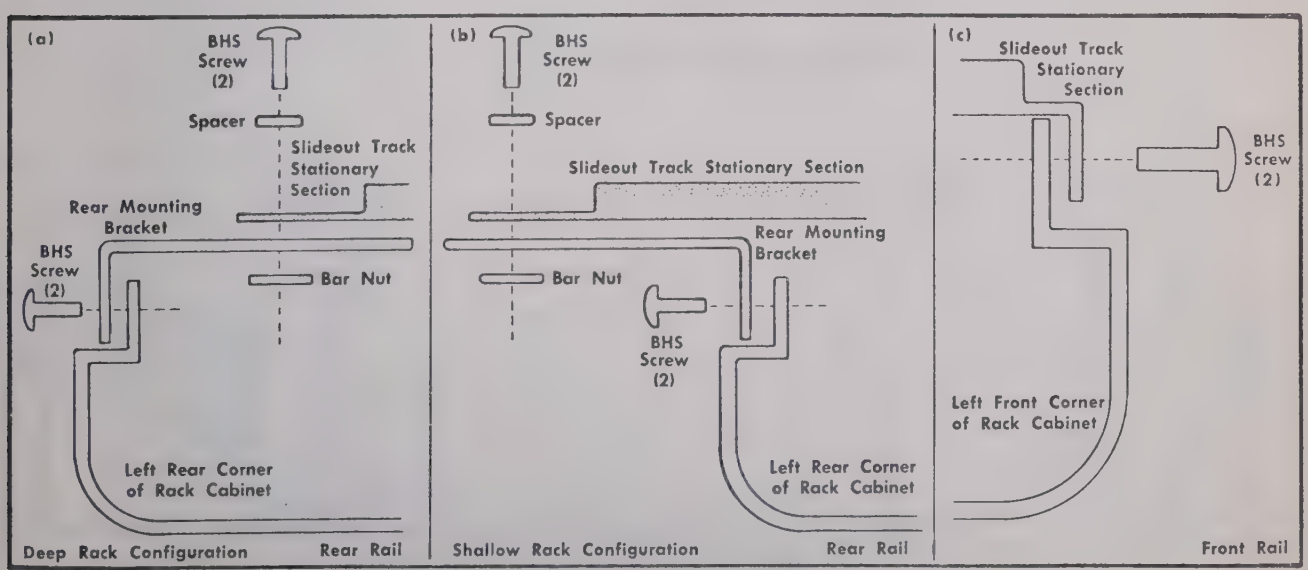


Fig. 8. Mounting the left stationary section to front rail tapped for 10-32 screws.

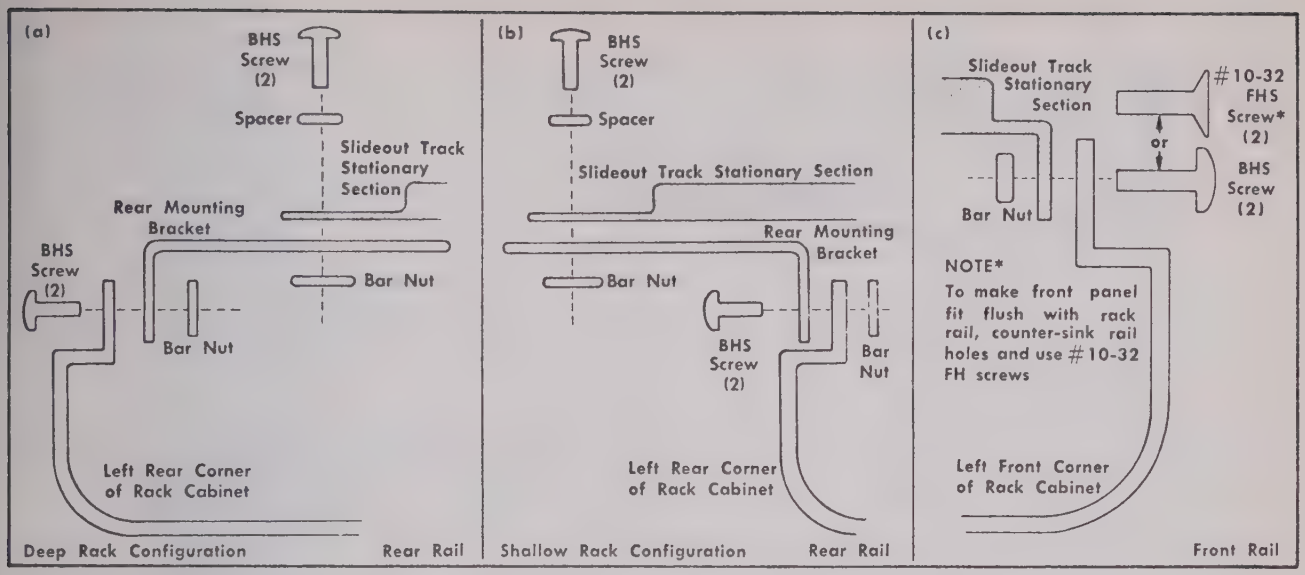


Fig. 9. Mounting the left stationary section to untapped front rail.

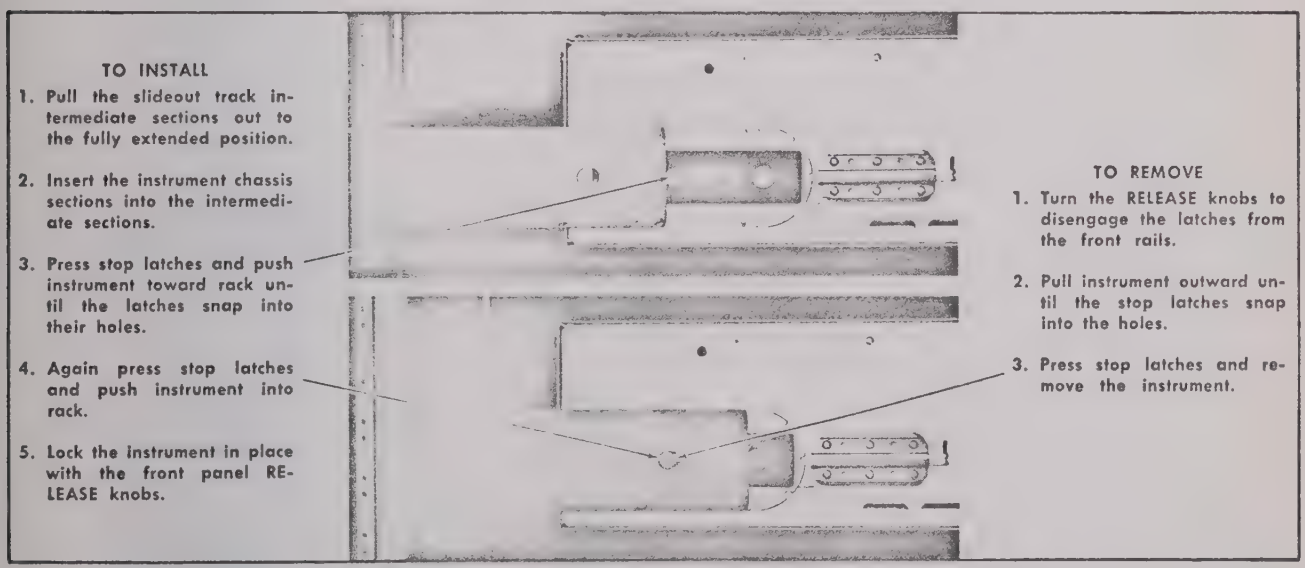

TO INSTALL
1. Pull the slideout track intermediate sections out to the fully extended position.
2. Insert the instrument chassis sections into the intermediate sections.
3. Press stop latches and push instrument toward rack until the latches snap into their holes.
4. Again press stop latches and push instrument into rack.
5. Lock the instrument in place with the front panel RELEASE knobs.
TO REMOVE
1. Turn the RELEASE knobs to disengage the latches from the front rails.
2. Pull instrument outward until the stop latches snap into the holes.
3. Press stop latches and remove the instrument.

Fig. 10. Installing and removing the instrument.

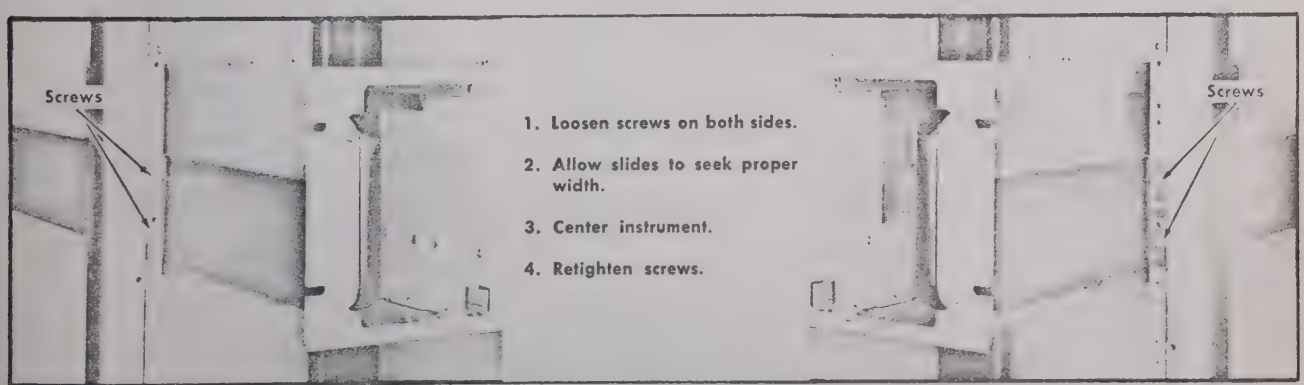
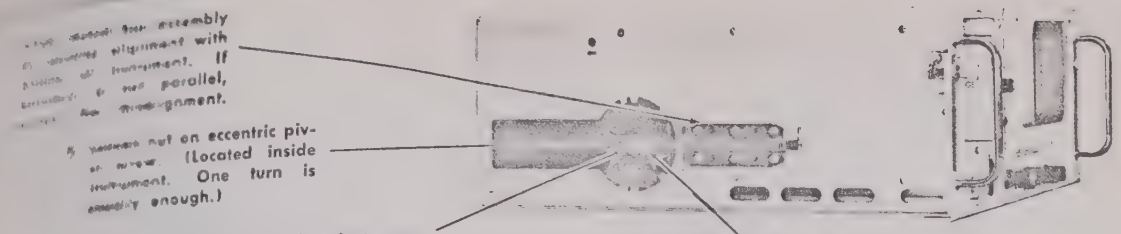


Fig. 11. Adjustment of the slideout tracks.



3. Turn eccentric pivot screw to make edge of track parallel with bottom of instrument.*

4. Hold eccentric pivot screw and retighten nut. Repeat these 4 steps for the other side of the instrument.

5. Reinstall the bottom dust cover and insert the plug-in units into their compartments.

* The eccentric pivot screws may be adjusted to shift the instrument up or down to maintain parallel alignment between left and right tracks, to center the instrument front panel in the space between upper and lower instruments in the cabinet and/or to allow the rear side of the front panel to fit properly to the front rack rails when the instrument is all the way in the rack.

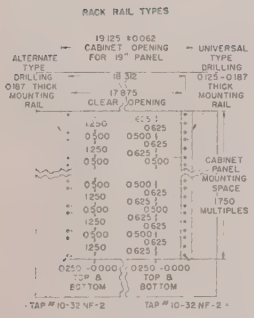
Fig. 12. Adjustment of the chassis section.

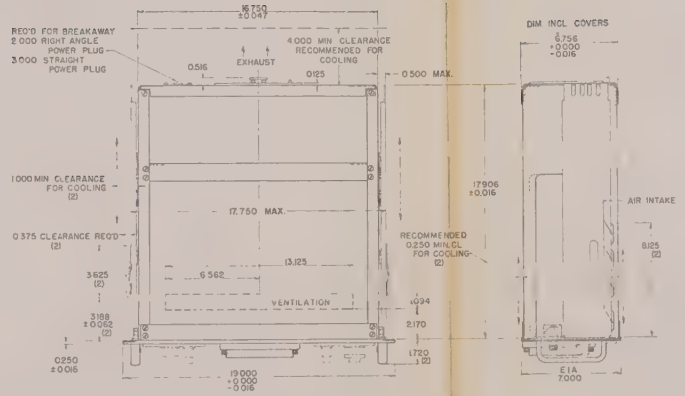
PARTS LIST

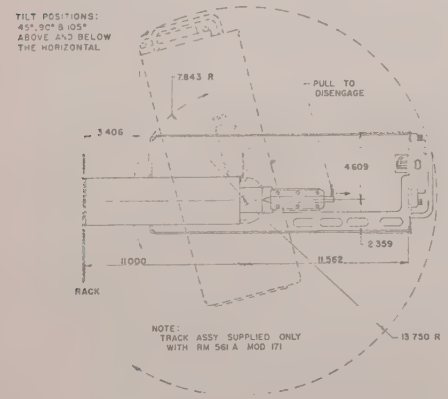
SLIDEOUT TRACK ASSEMBLY

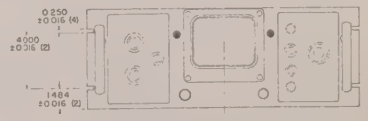
PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
351-050			1	TRACK, SLIDEOUT, ASSEMBLY
.....			.	Consisting Of:
351-027			1	TRACK, SLIDEOUT, chassis section
.....			.	Mounting Hardware Included:
NO NUMBER			12	SCREW
NO NUMBER			12	LOCKWASHER
NO NUMBER			12	NUT
351-011			1	TRACK, SLIDEOUT, stationary and intermediate sections, right
.....			.	Mounting Hardware Included:
NO NUMBER			1	BRACKET
NO NUMBER			1	SPACER
NO NUMBER			3	SPACER, with threaded holes
NO NUMBER			2	SCREW, FHS, phillips
NO NUMBER			6	SCREW, phillips
351-010			1	TRACK SLIDEOUT, stationary and intermediate sections, left
.....			.	Mounting Hardware Included:
NO NUMBER			1	BRACKET
NO NUMBER			1	SPACER
NO NUMBER			3	SPACER, with threaded holes
NO NUMBER			2	SCREW, FHS, phillips
NO NUMBER			6	SCREW, phillips

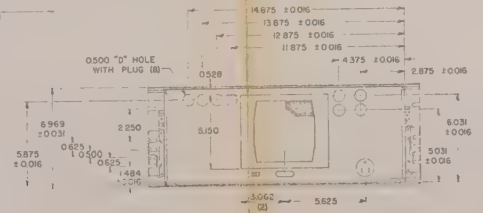
RACK RAIL TYPES



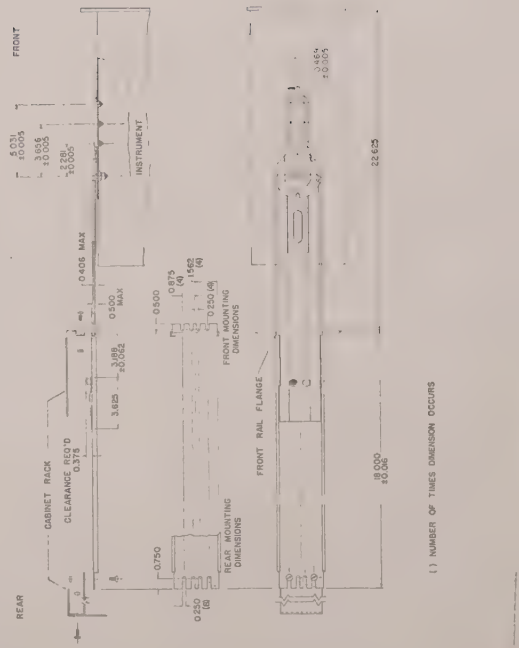








REAR VIEW



MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

TYPE RM561A TENT S/N 8740

PARTS LIST CORRECTION

CHANGE TO:

C830	283-0071-00	.0068 µfd	Cer.
C832	283-0071-00	.0068 µfd	Cer.
C837	283-0034-00	.005 µfd	Cer.
C853	283-0034-00	.005 µfd	Cer.

TYPE RM561A -- TENT. S/N 8270

PARTS LIST CORRECTIONS

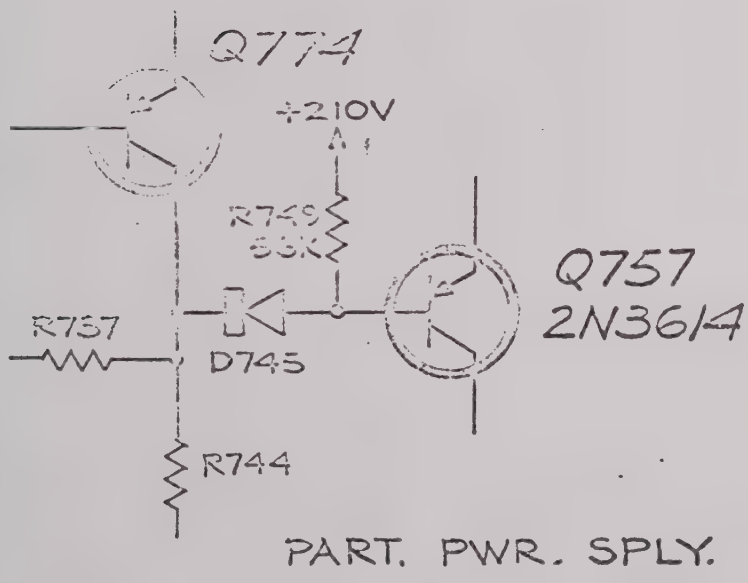
CHANGE TO:

Q757	151-0165-00	2N3614		

ADD:

D745	152-0107-00	1N647		
R749	303-0563-00	56 k	1 w	5%

SCHEMATIC CORRECTION



INSTRUCTION MANUAL

MODIFICATION INSERT

Serial Number _____

TYPE 3A1
MOD 236J

This insert has been written to supplement the Instruction Manual for the modified instrument. The information given in this insert will supersede that given in the manual.

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MOD 236J

Tektronix, Inc.
S.W. Millikan Way • P. O. Box 500 • Beaverton, Oregon • Phone MI 4-0161 • Cable: Tektronix

TYPE 3A1
MOD 236J

The Plug-In unit for which this insert was prepared has been modified to provide the following:

The front panel control knobs have been changed to ones with black matte finish. The Front Panel has been changed to a special panel finished by Photo Chemical Products.

The Inputs have been moved from the front panel to the rear plate for use with a suitably modified oscilloscope.

CALIBRATION

Calibrate this instrument as directed in the Calibration section of the manual, making input connections to the rear plate of a suitably modified Oscilloscope.

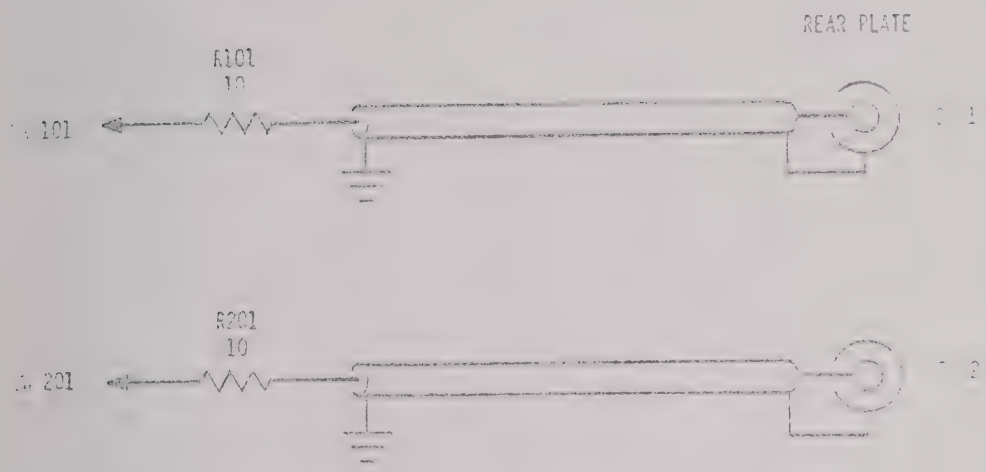
Some deterioration of waveform response can be expected due to the increase in lead length and the corresponding increase in input capacitance.

PARTS LIST CHANGES

The following parts have been added to this modified instrument. When ordering replacement parts, specify instrument type, serial number and MOD number. Include part number and description of the desired item.

BRACKET, Tag Mounting	Add	1	030-0244-02
CABLE, Coaxial, RG-174/U	Add		175-0068-00
CLAMP, Cable, 3/16"	Add	1	343-0002-00
CLAMP, Delrin, Size 'D'	Add	1	343-0089-00
CONNECTOR, DM-53743-5001	Add	2	036-0003-00
GROMMET, Snap-in, Delrin	Add	2	348-0031-00
HOLDER, Delrin Connector	Add	1	030-0192-02
KNOB (358-0178-00), Black Matte	Change	1	036-3031-00
KNOB (366-0031-00), Black Matte	Change	2	036-3033-00
KNOB (366-0140-00), Black Matte	Change	1	036-3039-00
KNOB (366-0148-00), Black Matte	Change	2	036-3042-00
KNOB (366-0160-00), Black Matte	Change	2	036-3046-00
KNOB (366-0250-00), Black Matte	Change	1	036-3054-00
KNOB (384-0304-00), Black Matte	Change	1	036-3059-00
PANEL, Front	Change	1	034-0041-00
RIVET, Pop	Add	4	13-1030-34
SWITCH, w/slider, Black Matte	Change	2	036-3026-00
TAG, I.D. and Serial, Film #2025	Add	1	034-0025-00

SCHEMATIC



INSTRUCTION MANUAL

Serial Number _____

TYPE 3A1

DUAL-TRACE AMPLIFIER

tronix, Inc.
S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon ● Phone MI 4-0161 ● Cables: Tektronix

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.

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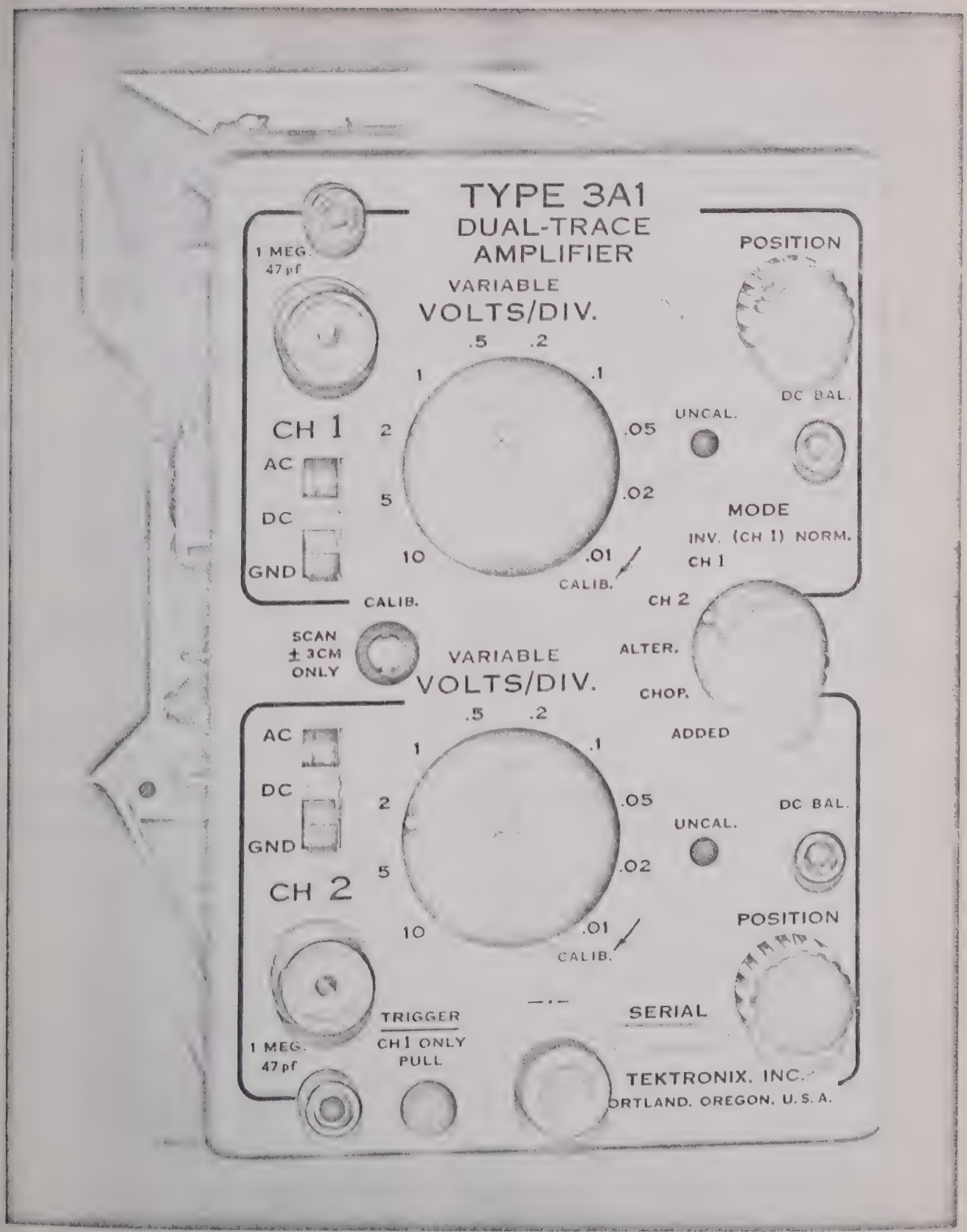

TYPE 3A1
DUAL-TRACE
AMPLIFIER
1 MEG.
47 pf
VARIABLE
VOLTS/DIV.
.5
.2
1
.1
2
.05
5
.02
10
.01
CALIB.
POSITION
DC BAL.
UNCAL.
CH 1
AC
DC
GND
MODE
INV. (CH 1) NORM.
CH 1
CALIB.
CH 2
SCAN
± 3CM
ONLY
ALTER.
CHOP.
ADDED
VARIABLE
VOLTS/DIV.
AC
DC
GND
CH 2
DC BAL.
UNCAL.
POSITION
TRIGGER
CH 1 ONLY
PULL
SERIAL
1 MEG.
47 pf
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

SECTION 1

CHARACTERISTICS

eneral

The Type 3A1 Dual-Trace Amplifier plug-in unit is de-gned to operate in Tektronix 560-Series Oscilloscopes. The it has two identical amplifier channels with a switching rcuit that can select independent operation of either chan-el, switch back and forth between channels either at an ternally set chopping rate or on alternate sweeps, or lect the algebraic sum of the two inputs.

OPERATING CHARACTERISTICS

ensitivity

Each channel has ten sensitivities from 0.01 volts/div 10 volts/div. in a 1, 2, 5 sequence. Accuracy is ±3% indicated sensitivity. Each channel has a variable atten-ator which may be used to introduce a continuously vari-ble attenuation to a maximum of 2.5 X the indicated nsitivity. A warning indicator lights when the variable tenuator is not in the calibrated position.

requency Response

Dc to 10 mc

isetime

35 nanoseconds

nput Impedance

1 megohm, paralleled by 47 pf (47 x 10^{-12} farads)

Input Coupling

Ac or dc coupling of signals may be selected for either channel. A 0.1 μf capacitor limits low-frequency response to about 2 cps on ac coupling.

Operating Modes

Channel 1 only: Channel 2 will not operate.

Channel 2 only: Channel 1 will not operate.

Alternate: Electronic switching between channels at the end of each sweep.

Chopped: Electronic switching between channels at a rate of about 100 kc, with a 5 μsec sample of each channel. Blanking occurs while switching is taking place.

Added: The algebraic sum of both signals is displayed. When the channel 1 signal is inverted, the difference is displayed.

Triggering

An internal signal for triggering is fed from the Type 3A1 through the indicator unit to the time-base plug-in unit. Trigger signals may be supplied from channel 1 only, or from channel 1 and channel 2, depending on which channel is displayed.

Mechanical Features

Construction: Aluminum alloy chassis

Finish: Photo-etched anodized front panel

Weight: Approx. 5 pounds

NOTES

SECTION 2

OPERATING INSTRUCTIONS

troduction

The Type 3A1 is normally used with a 560-Series Oscillo-pe to provide vertical deflection signals with respect to rizontal units of time provided by a time-base plug-in it such as the Tektronix Type 2B67. In some applications, amplifier plug-in unit instead of a time-base plug-in it can be used to provide horizontal deflection.

The following instructions are based on using a time-base g-in unit to provide the horizontal deflection. Typical plications of the Type 3A1 are given in Section 3 of s manual.

The operating instructions are divided into three sections: discussion of considerations necessary before making mea-rements with the Type 3A1, a procedure to be followed en operating the Type 3A1 for the first time, a list of front panel controls with a discussion of the operation each.

PRELIMINARY CONSIDERATIONS

Consider the following information before making the t setup.

nnections

It is often possible to make signal connections to the pe 3A1 with short-length, unshielded test leads*. This particiularly true for high-level, low-frequency signals. hen such leads are used, you must also use a ground nnection between the Type 3A1 or oscilloscope chassis ound and the chassis of the equipment under test. Posi-n the leads away from any stray electric or magnetic ld source to avoid obtaining erroneous displays.

In many low-level applications unshielded leads are un-tisfactory for making signal connections because of signal ckup resulting from nearby fields. To prevent unwanted gnal pickup, use shielded (coaxial) cables. Be sure the ound conductors of the cables are connected to the chassis both the oscilloscope and the signal source.

oading

As nearly as possible, simulate actual operating condi-ns in the equipment under test. For example, the equip-ent should work into a load impedance equal to that nich it will see in actual use.

Consider the effect of loading on the equipment under st caused by the input circuit of the Type 3A1. The input rcuit can be represented by a resistance of 1 megohm unted by a capacitance of 47 pf. With a few feet of shielded cable, the capacitance is increased considerably. Use a probe where the effects of resistive and capacitive loads will not affect the operation of the device under test or distort the signal.

*To make it easier to connect test leads to the unit, adapters ch as a single binding post fitted with a BNC plug (Tektronix rt No. 103-033) are available as optional accessories. These ms can be ordered through your local Tektronix Field Office.

Use of Probes

An attenuator probe reduces both capacitive and resistive circuit loading to a minimum and, at the same time, reduces plug-in sensitivity. The attenuation introduced by the probe permits measurements of signal voltages in excess of those that can be accommodated by the Type 3A1 alone. When making amplitude measurements with an attenuator probe, be sure to multiply the observed amplitude by the probe attenuation.

To assure the accuracy of pulse or high-frequency measurements, check the probe compensation.

To adjust the probe input-compensation capacitor, set the oscilloscope calibrator control for an output signal of suitable amplitude. For the Type 567 Oscilloscope, use the calibrator jack that provides the proper output amplitude.

First-Time Operation

The following procedure will help you become familiar with the Type 3A1 operation.

1. Preset channel 1 and channel 2 controls as follows:

AC-DC-GND switch	DC
VOLTS/DIV. switch	.5
VARIABLE VOLTS/DIV. control	CALIB.
POSITION control	Mid-range
MODE switch	CH 1
INV. (CH 1) NORM. switch	NORM.
TRIGGER	Pushed in

2. Connect a jumper from the oscilloscope calibrator to both plug-in input connectors and set the calibrator voltage to 1 volt. Adjust the time-base sweep rate for 5 msec/div and the triggering controls for a stable 2-division square wave display. Adjust the CALIB. control if necessary. Turn the channel 1 POSITION control to move the display above the center graticule line.
3. Turn the MODE switch to CH 2; a similar 2-division square wave should be seen. Turn the channel 2 POSITION control to move the display below the center graticule line.
4. Turn the MODE switch to ALTER.; the upper and lower square-wave display should be seen (The flicker depends on the setting of the time-base plug-in sweep rate).
5. Turn the MODE switch to CHOP.; the upper and lower square wave display will have less flicker than in the

ALTER. position. Set the time-base plug-in for 5 μsec/div. The individual chopped portions of the waveform will be seen.

6. Set the time-base plug-in for a 5 msec sweep rate and the Type 3A1 MODE switch to ADDED. The display should be one square wave, 4 divisions in amplitude. This is the channel 1 and 2 waveforms added together (2 divisions each). Notice that either Type 3A1 POSITION control will move the trace vertically.

7. Turn the INV. (CH 1) NORM. switch to INV. The display will be a straight line if the gain of both channels is exactly equal. Since both signals are 2 divisions, the difference between them is zero or a straight line.

Front Panel Controls

AC-DC-GND Switch

With this switch in the DC position, both the ac and dc components of the signal will be displayed. To remove the dc component, set the switch to the AC position. In the AC position, the dc component is blocked by a capacitor in the input circuit. The low frequency limit (3-db point) in the AC position is about 2 cps (about 0.2 cps when 10X probe is used).

In the GND position, this switch grounds only the Type 3A1 input; not the input connector.

VOLTS/DIV Switch

A ten position switch that sets the vertical sensitivity of the Type 3A1. VARIABLE VOLTS/DIV. control must be full clockwise with neon UNCAL. light extinguished for calibrated sensitivity. Range is from 0.01 volts to 10 volts/div. (100 volts/div. when 10X probe is used).

VARIABLE VOLTS/DIV. Control

The red knob on the VOLTS/DIV. switch is a variable resistor that provides continuously variable attenuation (uncalibrated) up to about 2.5 to 1. For example, if the VOLTS/DIV. switch is in the 1 volt position, the VARIABLE VOLTS/DIV. control will vary the sensitivity between 1 volt and 2.5 volts/division (uncalibrated). When used in conjunction with the oscilloscope calibrator voltage, this control can set any specific sensitivity within the range of the instrument.

UNCAL Light

A neon lamp that lights when the VARIABLE VOLTS/DIV. control is not in the CALIB. position.

POSITION Control

There are two POSITION controls; one for channel 1 and the other for channel 2. They both shift their respective channel displays in a vertical direction.

MODE Switch

A five position switch that sets the mode of operation. The positions are as follows:

CH 1 Connects the internal circuits to operate channel 1 only. Channel 2 will not operate.

CH 2 Connects the internal circuits to operate channel 2 only. Channel 1 will not operate.

ALTER. Sets the amplifier channels to display on alternate sweeps. For example, the first sweep would be the channel 1 signal, the second sweep the channel 2 signal. The flicker between channels will depend on the sweep rate of the time-base plug-in.

CHOP. Electronically switches between channels at a 100 KC rate with 5 μsec samples of each input shown on the display. The switching transients are removed by dual-trace blanking of the crt (See oscilloscope instruction manual).

ADDED The algebraic sum of the channel 1 and channel 2 signals will be displayed with the MODE switch in this position. To measure the difference between these signals, turn the INV. (CH 1) NORM. switch to INV.

INV. (CH 1) NORM. switch

A two position switch that presents the channel 1 signal in normal or inverted polarity.

TRIGGER CH 1 ONLY

A push-pull switch that connects the channel or channels in use to the time-base trigger circuits when pushed in, and connects channel 1 only to the trigger circuits when pulled out. It is especially useful in Alternate and Chopped modes where triggering becomes difficult with certain waveforms.

CALIB.

A screwdriver adjustment that sets the gain of the output amplifier. When the Type 3A1 is moved from one oscilloscope to another, adjust the gain to compensate for differences in crt sensitivities. Adjust the gain as follows:

1. Set the channel 1 AC-DC-GND switch to the DC and the MODE switch to CH 1.

2. Set the channel 1 VOLTS/DIV. switch to .05 and the VARIABLE VOLTS/DIV. control fully clockwise (CALIB.). Be sure the neon lamp (UNCAL.) is not lit.

3. Set the time-base plug-in triggering controls for a free-running sweep.

4. Connect a jumper from the oscilloscope calibrator to the channel 1 input connector. Apply a 100-millivolt signal from the calibrator.

5. SET the CALIB. control for exactly two major divisions of deflection.

6. Turn the MODE switch to CH 2 and apply the 100-millivolt signal to the channel 2 input connector. There should be two divisions of deflection. If the deflection is not two divisions, refer to the CH 2 GAIN procedure in the calibration section of this manual.

C BAL.

This control is a screwdriver adjustment of the dual-range "back lash" type. If the dc balance of a channel is not operly adjusted, the position of a no-signal trace will ift on the crt as the VARIABLE VOLTS/DIV. control of at channel is turned. To properly set the dc balance pro-ed as follows:

1. Set both AC-DC-GND switches to GND.
2. Turn the MODE switch to CH 1 and position a free-running trace to the center of the crt graticule.
3. Set the channel 1 DC BAL. control so there is no trace shift when the VARIABLE VOLTS/DIV. control is turned.
4. Repeat the above steps for channel 2.

NOTES

SECTION 3

APPLICATIONS

ltage Measurements

To measure the potential difference between two points c a signal (such as peak-to-peak ac volts), measure the rtical distance in graticule divisions between the two ints and multiply by the setting of the VOLTS/DIV. itch and the attenuation factor, if any, of the probe. Be e the VARIABLE VOLTS/DIV. control is set in the CALIB. sition.

To measure the dc level at a given point on a waveform, ceed as follows:

1. Set the VOLTS/DIV. switch so the expected voltage the input connector) is not more than six times the tting. Be sure the VARIABLE VOLTS/DIV. control is in the ALIB. position.

2. Set the time-base plug-in triggering controls for a e-running sweep.

3. Set the AC-DC-GND switch to GND and use the OSITION control to align the trace with one of the horintal graticule lines. This line will be used as a ground r zero) reference. The position of the reference line should e chosen for the polarity and amplitude of the signal to e measured. Do not move the POSITION control once e reference line has been established.

4. Move the AC-DC-GND switch to DC.

5. Apply the signal to the input connector and set the me-base plug-in triggering controls for a stable display.

6. Measure the vertical distance, in graticule divisions, om the ground (zero) reference line to the point you wish measure on the waveform.

7. Multiply this distance by the setting of the VOLTS/DIV. witch and any probe attenuation factor. This is the instanneous dc level of the point measured.

You can re-establish the zero reference line at any time y setting the AC-DC-GND switch to GND. It is not necesary to disconnect the signal probe from the Type 3A1. you wish to establish a reference other than zero, set the C-DC-GND switch to DC and touch the signal probe to e desired reference voltage, then use the POSITION control align the trace with a reference graticule line.

oltage Comparison Measurements

In some applications you may want to establish a set of rtical sensitivity values other than those selected by the OLTS/DIV. switch. This is convenient when you compare ignals that are exact multiples of a given reference. To stablish a set of sensitivity values based on some specific eference, proceed as follows:

1. Apply the reference signal to either input connector. Set the VOLTS/DIV. switch and VARIABLE VOLTS/DIV. control to adjust the amplitude of the display for an exact number of graticule divisions. Do not move the VARIABLE VOLTS/DIV. control after this setting.

2. Divide the amplitude of the reference signal (in volts) by the product of the deflection established in step 1 (in graticule divisions) and the setting of the VOLTS/DIV. switch. The result is the sensitivity conversion factor.

$$\text{Conversion Factor} = \frac{\text{Amplitude of Reference Signal (in volts)}}{\text{Amount of Deflection in graticule divisions} \times \text{VOLTS/DIV. Switch Setting}}$$

3. To calculate the true sensitivity at any setting of the VOLTS/DIV. switch, multiply the switch setting by the sensitivity conversion factor.

$$\text{True Sensitivity} = \text{VOLTS/DIV. Switch Setting} \times \text{Conversion Factor.}$$

This new set of sensitivity values applies to this channel only, and only as long as the VARIABLE VOLTS/DIV. control is not moved.

Phase-Difference Measurements

A phase comparison between two sine waves of the same frequency can be made by using the dual-trace feature of the Type 3A1. To make this comparison, proceed as follows:

1. Apply one signal to each of the input connectors, and set the MODE switch to CHOP. or ALTER. Pull out TRIGGER CH 1 only switch and internally trigger the time-base plug-in.

2. With the POSITION controls, center both signals vertically on the graticule.

3. Set the time-base plug-in sweep rate so one cycle of one waveform covers exactly 9 graticule divisions horizontally. Thus, each division represents 40° of one cycle at this sweep rate.

4. Measure the horizontal distance, in graticule divisions, between the leading waveform and the lagging waveform at the horizontal center graticule line. Multiply this distance by 40° per division to obtain the phase difference between the two signals.

For more precise measurements, increase the horizontal sweep rate with the magnifier. In step 3, each division on the graticule represents 40°. If the sweep rate is increased 5 times, then each division represents 8°.

NOTES

SECTION 4

CIRCUIT DESCRIPTION

neral

he Type 3A1 Dual-Trace Amplifier contains two identi- d input channels, a common output amplifier, a switching cuit, and a trigger amplifier. The output of either or th input channel amplifiers may be fed to the output plifier, depending on the condition of the switching cuit. Thus, the switching circuit makes it possible to dis- y one signal as a single trace on the crt, two signals ultaneously in a dual-trace display, or the algebraic n or difference of two signals as a single trace. Fig. 4-1 a block diagram of the Type 3A1.

put Channel Amplifiers

Each input channel consists of an attenuation network, an ut cathode-follower, and a three-stage amplifier with itched outputs. The input cathode-followers V113 and 23 (channel 1) and V213 and V223 (channel 2) isolate the enuator input circuitry from emitter-followers Q133 and 143 (channel 1) and Q233 and Q243 (channel 2). These nsistors provide low-impedance drive to the next stage: 134 and Q144 (channel 1), and Q234 and Q244 (channel 2). The output of these stages is fed to the diode gates in e switching circuits, which select the signals to be fed to the common output amplifier. The gain of the last stages in the input amplifiers is variable, with two calibration adjustments: R149 (channel 1), and R249 (channel 2) set the gain of the stage with the VOLTS/DIV. switches in the .01 position; R147 (channel 1), and R247 (channel 2) set the gain of the stage in the remaining positions of the VOLTS/DIV. switches. The VARIABLE VOLTS/DIV. control increases cathode degeneration when moved from the CALIB. position.

The input attenuators are resistance dividers with capacitive compensation. The attenuators maintain an input impedance of 1 megohm paralled by 47 pf. With the VOLTS/DIV. switch in the .01 and .02 positions, the input is fed directly to the cathode-follower stages (V113 and V213). The 10MV GAIN controls adjust the amplifier sensitivity with the VOLTS/DIV. switches in the .01 position and the 20MV GAIN controls adjust the sensitivity in the remaining positions. In the VOLTS/DIV. switch positions which provide an input deflection factor greater than 20 mv per division (.02 to 10 on VOLTS/DIV. switch), the attenuator sections are stacked. In the .05 VOLTS/DIV. switch position, the 2.5X attenuator increases the basic 20 mv per division deflection factor to 50 mv per division. The 5X attenuator is used to increase the deflection factor to 100 mv per division in the .1 VOLTS/DIV. switch position. These three positions (1X, 2.5X, and 5X) are preceeded by the X10 or

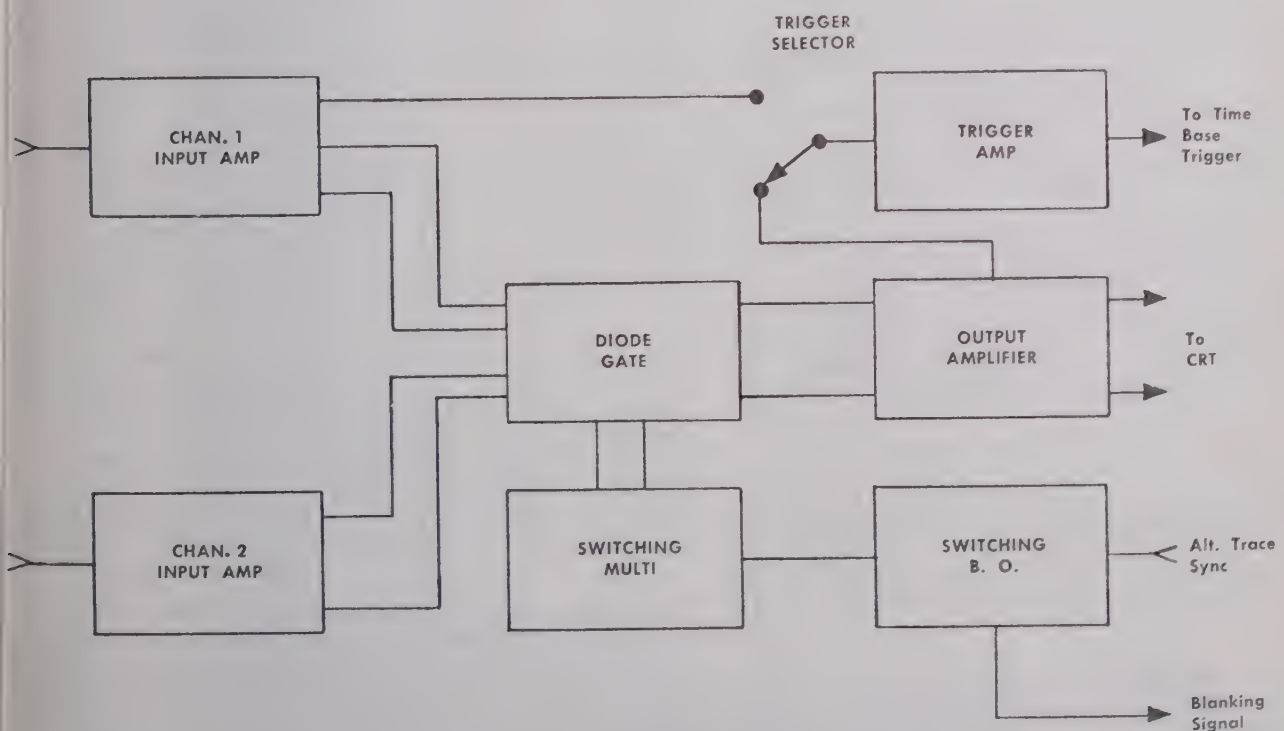


Fig. 4-1. Type 3A1 Block Diagram

X100 attenuators in the higher deflection factor positions of the VOLTS/DIV. switch.

The DC BAL. controls in the grid circuit of V123 and V223 adjust the potential at both emitters of each input amplifier so no current will flow through R139 and R149 (channel 1), and R239 and R249 (channel 2) under no-signal conditions. Otherwise, the position of a no-signal trace would shift on the crt as the VARIABLE VOLTS/DIV. control or channel Gain adjustments were turned.

In the INV. position the INV. (CH 1) NORM. switch (SW155) inverts the channel 1 output to the diode gates.

The channel 1 input amplifier contains a three-stage trigger amplifier. The first stage is an emitter-coupled paraphase amplifier (Q164 and Q174) with double-ended input and single-ended output. The dc level of the output is set by CHAN. 1 TRIG. DC LEVEL control R171. The output of this stage is fed to emitter-follower Q173. Q173 drives the third stage, Q184, which is collector-coupled to the trigger-amplifier section of the output amplifier.

Switching Circuits

The switching circuit consists of two diode gates, a switching multivibrator, and a switching blocking oscillator which drives the multivibrator. In the following discussion, assume that the MODE switch is in the CH 1 position.

Each diode gate consists of two series diodes and two shunting diodes. When signals are to pass through the gate to the output amplifier, the series diodes are forward biased, and the shunt diodes are back biased, allowing the signal to drive the bases of Q304 and Q314. Voltage to hold the series diodes (D155 and D158 in channel 1) in conduction is supplied through the emitter-base junctions of Q304 and Q314. Collector current for Q134 and Q144 flows through the series diodes. Shunt diodes D156 and D157 are back biased and thus cut off by MODE switch SW290, holding Q285 in the "off" state. Q275 is "off", and the junction of D156 and D157 is at —1.18 volts. The dc level in the signal output lines from the channel 1 input amplifier is —1.65 volts, and thus the shunt diodes are back biased.

In channel 2 diode gate, D256 and D257 are held at about —4.7 volts by Q285, which is "off". This holds the channel 2 output lines at about —4.3 volts. Since the outputs of the diode gates are about —2 volts, D255 and D258 are back biased. With D255 and D258 cut off, the signal is not transmitted to the output amplifier. In addition, D256 and D257, when conducting, form a low-impedance path for any signals coming to the diode gate from channel 2 input amplifier.

When the MODE switch is in the CH 2 position, the conditions of the diode gates are reversed. In the channel 2 diode gate, D256 and D257 are back biased and the signal from the channel 2 input amplifier passes through D255 and D258 to the output amplifier.

When the MODE switch is in either the ALTER or CHOP positions, Q275 and Q285 operate as a common Eccles-Jordan bistable multivibrator. Positive pulses from the switching blocking oscillator pass through D278 or D288 to the collector of the "off" state transistor. This pulse is transmitted by either C277 or C287 to the base of the "on" transistor, turning it "off". The collector of the "off" transistor moves toward the —12.2-volt supply, turning the other transistor "on" because of the coupling through either C277 or C287. Resistive dividers R277-R286 and R287-R276 set the levels at the transistor bases. The levels are designed so switching action can occur when pulses are received from the blocking oscillator.

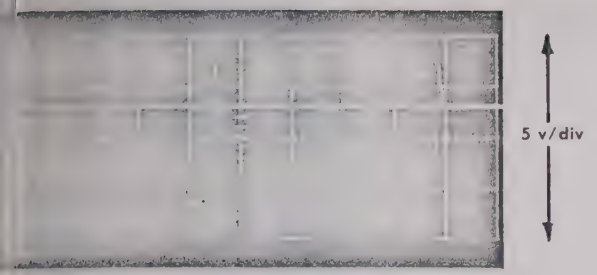
Operation of the diode gates in ALTER and CHOP is the same as described in the CH 1 and CH 2 positions of the MODE switch. However, the multivibrator is free to switch states when it receives a trigger signal, and thus operate the diode gates and transmit a signal to the output amplifier from channel 1 and channel 2 alternately. Also, in the ALTER and CHOP positions of the MODE switch, R292 is bypassed and the —12.2-volt supply is connected directly to the multivibrator circuit. In the other positions of the MODE switch, the multivibrator draws current through R292 and is not able to switch the diode gates. In the CH 1 position, additional current is supplied through R289; in the CH 2 position, current is supplied through R279.

When the MODE switch is in the ADDED position, current is supplied to the ouput amplifier through R293 and R294, holding the series diodes in both diode gates in conduction. Since the multivibrator transistors are both near cutoff, the diode-gate shunt diodes are back biased and thus inoperative.

In the CHOP and ALTER positions of the MODE switch, Q260 (the switching blocking oscillator) is energized, supplying pulses to the switching multivibrator. Fig. 4-2 shows the blocking oscillator waveforms with the MODE switch in the CHOP position. In the ALTER mode, the emitter of Q260 is connected to the —12.2-volt supply through R260. The base is also connected to the —12.2-volt supply through the base winding of blocking oscillator transformer T263. When a positive pulse is fed from the time-base plug-in unit through terminal 3 of the interconnecting plug, the emitter voltage rises. The transistor conducts, drawing current through the collector winding of blocking oscillator transformer T263, driving Q260 further into conduction. A normal blocking-oscillator cycle occurs with the backswing cutting the transistor off. The circuit is damped so the transistor is not turned on again until another sync pulse is received.

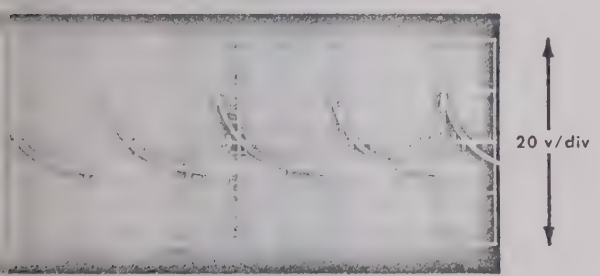
In the CHOP position of the MODE switch, the emitter of Q260 is connected to ground through R262. Normal blocking oscillator action occurs; however, when a cycle is completed, the base is forward biased since it is connected to the —12.2-volt supply. The blocking oscillator is thus automatically triggered and free-runs at a 150-kc rate.

Pulses from the collector circuit of Q260 are fed to the switching multivibrator through C266. Only the positive pulses, which occur at the beginning of the blocking oscillator cycle, will switch the multivibrator. The collector pulse is also fed to pin 24 of the interconnecting plug for use as a blankinng pulse in the crt circuit of the oscilloscope.



Signal at base of Q260

Signal at collector of Q260



Output to pin 24 of Interconnecting Plug

. 4-2. Signals in blocking oscillator circuit. Oscilloscope ac upled, sweep rate 2 μsec/div.

utput Amplifier

The output of the diode gates passes to Q304 and Q314. ese transistors are arranged as a common-base push-pull nplifier. The signal passes from the collectors of these transistors to a second pair of current amplifier, Q323 and Q333. These transistors are connected as emitter-followers and couple the signal to the grids of V334. The push-pull signal drives the grids, and the output is taken from the plate circuit. V334 is stabilized against characteristic changes by 'long-tailing' through R329 and R339 to the —100 volt supply. D337 and D338 in the cathode circuit improve the linearity of the amplifier near the end of its dynamic range by shunting cathode coupling resistor R337 on large signals. In the plate circuit of V334, peaking coils L326, L341, L336, and L351 improve the high-frequency response of the amplifier.

The signal is direct-coupled through parasitic suppression resistors R341 and R351 to the grids of V353. This tube is connected as a cathode-follower and because of its high input impedance, presents almost no load to the previous stages. The signal is coupled from the cathodes of V353 to the grids of output tubes V364 and V374. L344 and L354 in the coupling network provide additional high-frequency peaking while L345 (ferrite bead) and L355 (ferrite bead) are parasitic suppressors.

Output tubes V364 and V374 operate as a conventional push-pull amplifier. R374 (CALIB.) can be adjusted to match the deflection plate sensitivity of the crt. This control varies cathode degeneration, and thus changes the output voltage swing of the amplifier. Maximum deflection occurs when this control is set for zero resistance. The two diodes D375 and D376 improve linearity on large signals by shunting R364. The two cathode resistors R367 and R377 return through R378 to Zener diode D378. This diode, together with L378 and C378, forms a +15-volt power supply that is used in the amplifier input circuit.

The plate circuits of V364 and V374 each contain two inductors: L361 and L363 in the plate of V364, and L373 and L371 in the plate of V374. These peaking coils tend to neutralize the effect of plate and distributed capacity, and thus improve the high-frequency response of the amplifier.

A portion of the output signal is picked off the center-tap of L363 and coupled to trigger amplifier V383A. This tube is connected as a cathode-follower and the signal is passed to the TRIGGER switch. In normal operation, this front-panel switch is pushed in and the trigger signal passed to the time-base plug-in comes from V383A. If the TRIGGER switch is pulled out, the trigger signal is coupled from the cathode of V383B (channel 1 signal).

SECTION 5

MAINTENANCE and TROUBLESHOOTING

PREVENTIVE MAINTENANCE

alibration

The Type 3A1 Dual-Trace Amplifier plug-in unit will not quire frequent calibration. However, to insure that the it is operating properly at all times, we suggest that you eck the caibration after each 500-hours of operation (or ery six months if the unit is used intermittently). A mplete step-by-step procedure for calibrating the unit id checking its operation is given in the Calibration section this manual.

The accuracy of measurements made with the Type 3A1 epends not only on the accuracy of calibration, but also the calibration of the associated oscilloscope. It is portant that the oscilloscope is in proper calibration.

isual Inspection

Troubles can sometimes be found by a visual inspection of e unit. For this reason, you should perform a thorough sual check each time the instrument is calibrated or re-aired. Look for such defects as loose or broken connections, amaged connectors, improperly seated tubes, scorched or urned parts, broken terminal strips, etc. The remedy for ost of these troubles is apparent; however, heat-damaged arts are often the result of other, less apparent trouble. is essential that you determine the cause of overheating efore replacing heat-damaged parts.

ube Checks

Tube-tester checks are not recommended. Tube testers ometimes indicate that a tube is defective when that tube perates satisfactorily in a circuit, or the tester may fail to dicate tube defects which affect the performance of the ircuits. Determine the usability of a tube by whether or ot it works properly in the circuit. If it does not, then it hould be replaced. Unnecessary replacement of tubes is ot only expensive but may also result in needless recali-ration of the instrument.

COMPONENT REPLACEMENT

General

The procedures for replacing most parts in the Type 3A1 re obvious. Detailed instructions for their removal are herefore not required. In some cases, however, additional nformation may help you. This information is contained in he following paragraphs. Because of the circuit configura-ion, it will be necessary to recalibrate portions of the ircuit when certain parts are replaced. Refer to the Cali-ration section of this manual.

Switches

If a switch is removed, carefully note the lead connections to the switch to facilitate connecting the new switch.

Single wafers are not normally replaced on the switches used in the Type 3A1. If one wafer is defective, the entire switch should be replaced. Switches may be ordered from Tektronix either unwired or with the parts wired in place (See Parts List).

Soldering Precautions

In the production of Tektronix instruments a special silver-bearing solder is used to establish a bond to the ceramic terminal strips. This bond may be broken by repeated use of ordinary tin-lead solder, or by excessive heating of the terminal strip with a soldering iron. Occassional use of ordinary 60-40 solder will not break the bond unless excessive heat is applied.

If you are responsible for the maintenance of Tektronix instruments, it is advisable to have a stock of solder containing about 3% silver. This type of solder is used in printed circuitry, and is generally available locally. It may also be purchased from Tektronix in one-pound rolls; order by part number 251-514.

Because of the shape of the terminals of the ceramic terminal strips, use a wedge-shaped tip on your soldering iron. These tips allow you to apply heat directly to the solder in the terminals. It is important to use as little heat as possible while producing a full-flow joint.

The proper technique for soldering components in place requires: (1) Long-nose pliers to hold the lead securely between the component and the point where heat is applied, allowing the pliers to serve as a heat sink; (2) a hot iron applied for a short time, and (3) careful manipulation of the leads to prevent lead breakage. Use a 50- to 70-watt iron when working on ceramic strips.

Ceramic Terminal Strips

Damaged ceramic terminal strips are most easily removed by unsoldering all connections, then knocking the plastic yokes out of the chassis. This can be done by using a plastic or hard rubber mallet to hit the ends of the yoke protruding through the chassis. If space limitations prohibit use of the mallet directly, a plastic rod can be used between the mallet and the yoke of the strip. When the two yokes supporting the strip have been knocked out of the chassis, the strip and yokes can be removed as a unit. The spacers will probably come out with the yokes; if not, they can be removed separately.

Another way of removing the terminal strip is to cut off one side of the yoke with diagonal cutters. This permits the

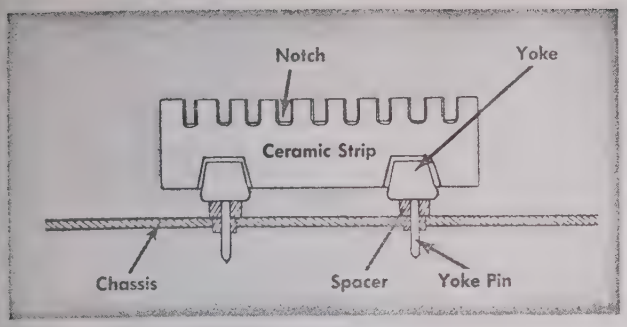


Fig. 5-1. Ceramic terminal strip installation.

strip to be removed from a difficult area where a mallet cannot be used. The remainder of the yokes and the spacers can be pulled out separately. Since a replacement strip is supplied with yokes already attached, the old yokes need not be salvaged. However, the old spacers may be used again.

When the damaged strip and yoke assembly has been removed, place the spacers into the holes in the chassis. Then set the ends of the yoke pins into the spacers. Press or tap lightly directly above the yokes to drive the yoke pins down through the spacers. Be certain that the yoke pins are driven completely through the spacers. Then cut off the portion of the yoke pin protruding past the spacers. Fig. 5-1 shows how the ceramic strip parts fit together.

TROUBLESHOOTING

General Troubleshooting Information

This portion of the manual is intended to help you troubleshoot the Type 3A1 in the event of trouble.

Since the Type 3A1 derives all of its operating voltages from the oscilloscope, and depends on the oscilloscope for its display, you must be sure that the oscilloscope is not the cause of trouble. Trouble can usually be isolated to either the oscilloscope or plug-in unit by substituting another plug-in for the suspected one and checking for proper operation. Or you can insert the suspected Type 3A1 in another oscilloscope and check for proper operation.

If trouble occurs in the Type 3A1, try to isolate it by quick operational and visual checks. First check the settings of all controls. Then operate the controls to see what effect, if any, they have on the trouble. The normal or abnormal operation of each control may help you to establish the trouble symptoms. (The cause of trouble which occurs only in certain positions of a control can usually be determined immediately from the trouble symptoms.)

After the trouble symptoms are established, look first for simple causes. Check to see that the pilot light of the oscilloscope is on, feel for any irregularities in the operation of the controls, listen for any unusual sound, see that the tube filaments are lit, and visually check the entire instrument. The type of symptom will generally indicate the checks to make.

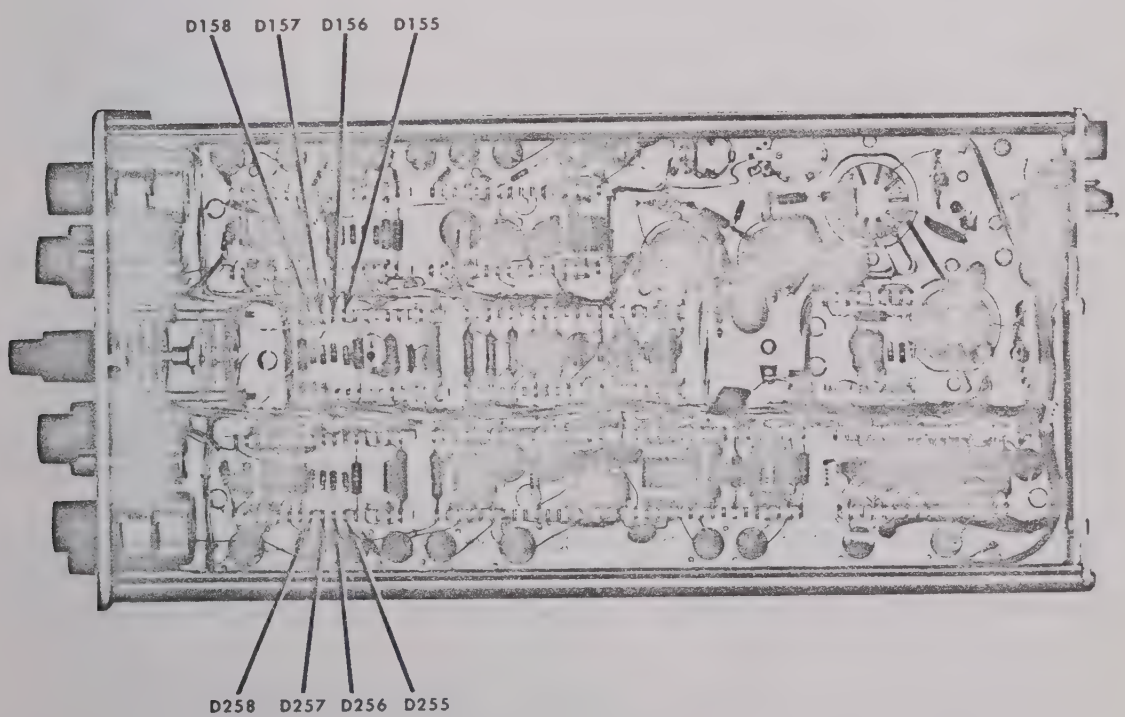


Fig. 5-2. Location of Type 3A1 major components.

n general, a troubleshooting procedure consists of two
fts: circuit isolation and circuit troubleshooting. After
olating the circuit, you can then troubleshoot in the circuit
find the cause of the trouble.

Most troubles are caused by tube or semiconductor fail-
s. Therefore, when trouble has been isolated to a circuit,
tubes and semiconductors in that circuit should be
ecked (by substitution). Be sure to return tubes or transistors
ind to be good to their original socket.

Switch wafers shown with the circuit diagrams are coded
indicate the position of the wafer on the switches. The
mber portion of the code refers to the wafer number on
switch assembly. Wafers are numbered from the front
the switch to the rear. The letters F and R indicate whether
front or the rear of the wafer is used to perform the
rticular switching function.

Test Points

Major components in the unit are shown on the schematics
d in Fig. 5-2. A test point is indicated by a number with a line indicating the location of the test point in the circuit. Test points are used as an aid in troubleshooting and calibrating the unit, and the reference to these points is made in Table 5-1 and in the Calibration section of this manual.

Voltages are shown at many test points on the schematics. When necessary, the conditions under which the voltages were obtained also appear on the schematics.

NOTE

Because the output amplifier is completely balanced, a bad tube or transistor will usually shift the trace off the crt. If the vertical signal is low or absent, but the trace is normal, the trouble symptom will be caused by some component that is common to both transistors or tubes in an amplifier pair.

TABLE 5-1

TROUBLE SYMPTOM	PROBABLE CAUSE	CHECK
1. No spot or trace on either channel.	Output amplifier not balanced. Bad tube or transistor in output amplifier.	Connect a short across the vertical deflection pins on the crt. If a trace appears, the vertical amplifier is unbalanced. Check for voltage difference across each pair of amplifiers.
2. No vertical signal on crt from either channel.	Defective component in one of the balanced amplifiers.	Check plate voltage of V364 and V374.
3. Vertical signal only on one channel. POSITION control of defective channel does not operate but trace is normal.	Shorted multivibrator transistor. Shorted or open diode in diode gates.	Check Q275 and Q285. Check diodes in diode gate of defective channel (D155 and D158, D255 and D258).
4. Sweep will not alternate. (ALTER. mode)	Blocking oscillator Q260 not operating. Diodes D278 or D288 open or shorted. Multivibrator not operating.	Check for sync pulse at the emitter and collector of Q260. Check diodes. Check multivibrator transistors Q275 and Q285, and diodes D278 and D288.
5. Sweep will not operate in the CHOP. mode.	Blocking oscillator not operating.	Check blocking oscillator Q260 for trigger waveform to multivibrator (Q275 and Q285).
6. Sweep will not trigger in either position of TRIGGER CH 1 ONLY switch.	Multivibrator not operating. Trigger cathode-follower not operating.	Check multivibrator transistors Q275 and Q285, and diodes D278 and D288. Check V383.
7. Sweep will not trigger when TRIGGER CH 1 ONLY switch is pulled out.	Channel 1 trigger amplifier. CHAN. 1 TRIG. DC LEVEL R171 not correctly set.	Check Q164, Q174, Q173, and Q183. Check calibration procedure for correct settings of R171.
8. Dc reference-level shift. Trace shifts when AC-DC-GND switch is changed from DC to GND.	DC BAL. (R119 and R219), not adjusted correctly. Input cathode-follower tubes gassy.	Refer to calibration procedure for adjustment of DC BAL controls. Check V123 and V223.

NOTES

SECTION 6

CALIBRATION PROCEDURE

roduction

he Type 3A1 Dual-Trace Amplifier plug-in unit should b calibrated at least every six months or after every 500 rs of operation, whichever occurs first. When transistors, tes, or other components are changed, the calibration of repaired circuit should be checked.

Sometimes trouble in the instrument is caused by changes in component values. The cause can often be found by ecking the calibration of the suspected circuit. Use this cedure together with the troubleshooting charts in section 5.

The following instructions are arranged in sequence to calibrate the instrument without unnecessary repetition of checks and adjustments.

quipment Required

1. 560-Series Oscilloscope
2. Time-Base unit for 560-Series Oscilloscope
3. Dc voltmeter, at least 5000 ohms per volt, 2% accuracy.
4. Square-Wave Generator with a frequency range between 100 cycles and 300 kc. Risetime of 20 nanoseconds or less, and at least 0.25 volt output amplitude, such as Tektronix Type 105 Square-Wave Generator.
5. Input Capacitance Standardizer, such as Tektronix Type CS47.
6. 5XT Attenuator, such as Tektronix Part No. 011-032 (or Type B52-T5).
7. Non-metal alignment tool, such as Tektronix Part No. 003-301.

Preliminary

Install the Type 3A1 in the left-hand opening of the oscilloscope, and the time-base plug-in unit in the right-hand opening. Remove both side covers of the oscilloscope. Turn the oscilloscope power on and allow it to warm up for at

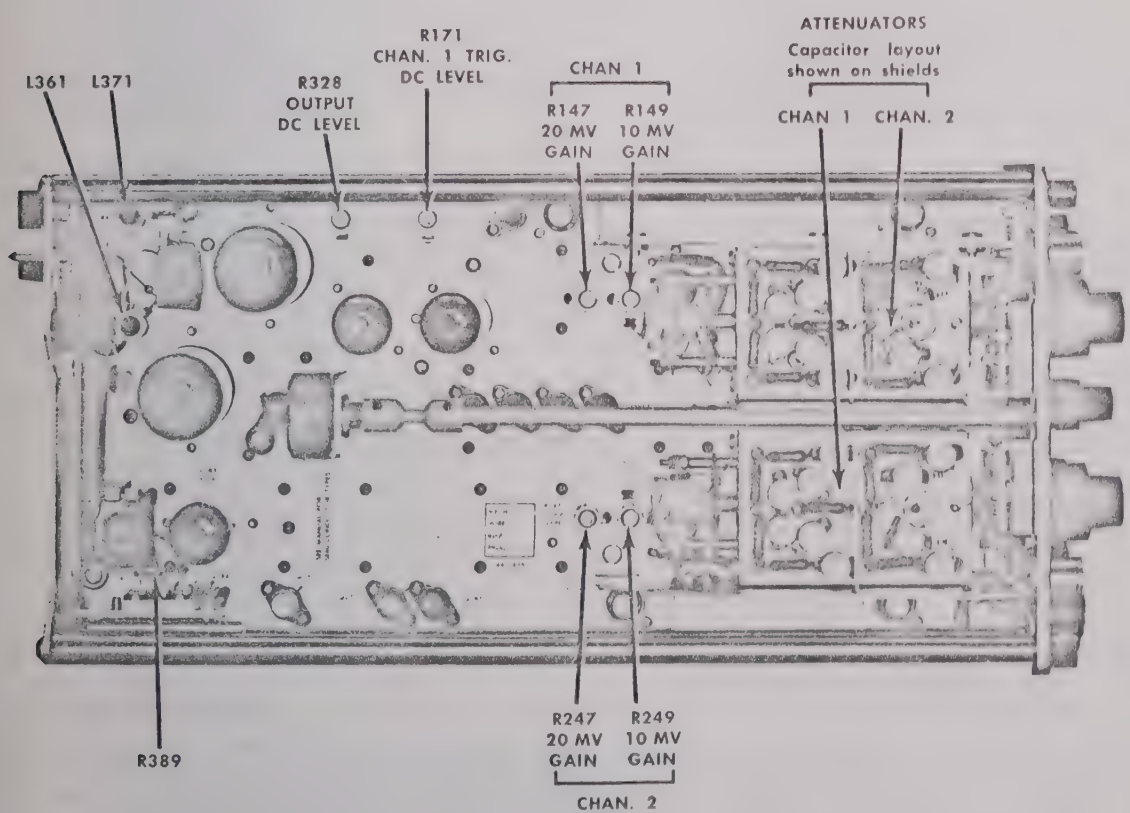


Fig. 6-1. Location of Type 3A1 calibration controls.

least fifteen minutes. Set the time-base plug-in for a 1 millisecond/div. free-running sweep. Set the controls for both channels of the Type 3A1 as follows:

POSITION	midrange
VOLTS/DIV	.01
VARIABLE VOLTS/DIV.	CALIB.
AC-DC-GND	GND.
MODE	ALTER.
INV. (CH 1) NORM.	NORM.
CALIB.	Fully clockwise
DC BAL.	midrange

Procedure

1. Adjust Output Dc Level

Push in the TRIGGER CH 1 ONLY switch. Position the trace to the graticule horizontal centerlines. Measure the dc voltage from each of the crt vertical deflection plates to ground. Adjust R328 OUTPUT DC LEVEL so the average of the two voltages is +190 volts.

2. Adjust Channel 1 and 2 Dc Balance.

Position the channel 1 trace to the graticule horizontal centerline. Adjust R119 DC BAL. (Channel 1 front panel adjustment) so the trace does not move as the Channel 1 VARIABLE VOLTS/DIV. control is turned through its range. Repeat this adjustment for R219 DC BAL. in channel 2 as the Channel 2 VARIABLE VOLTS/DIV. Control is turned.

3. Adjust Channel 1 Trigger Dc Level

Turn the MODE switch to CH 1 and pull out the TRIGGER CH 1 ONLY switch. Connect the dc voltmeter to R389 at switch SW390 (see Fig. 6-1). Adjust R171, CHAN. 1 TRIG. DC LEVEL for zero volts on the meter.

4. Adjust Channel 1 Gain and Calibration.

Push the channel 1 AC-DC-GND switch to DC. Set the VOLTS/DIV. switch to .01 and the VARIABLE VOLTS/DIV. control to CALIB. Connect a 50-millivolt signal from the calibrator output to the channel 1 input. Adjust R149 10 MV GAIN for six major divisions of vertical deflection. Then adjust R364 CALIB. (front panel) until the vertical deflection is five major divisions. Set the VOLTS/DIV. switch to .02 and the oscilloscope calibrator output for 100 millivolts. Adjust R147, 20 MV GAIN for five major divisions of vertical deflection.

5. Adjust Channel 2

Connect another cable from the oscilloscope calibrator output to the channel 2 input connector. Set the channel 2 AC-DC-GND switch to DC. Set both channel VOLTS/DIV. switches to .01. Set the calibrator output for 50 millivolts. Set the MODE switch to ADDED and the INV. (CH 1) NORMAL switch to INV. Adjust R249, 10 MV GAIN, for cancellation of the display shown by a single line of trace. Set the calibrator output for 100 millivolts and both VOLTS/DIV. switches to .02. Adjust R247 20 MV GAIN for cancellation of the display.

6. Check Both VARIABLE VOLTS/DIV. controls.

Set both VOLTS/DIV. switches to .01 and both VARIABLE VOLTS/DIV. controls to CALIB. Set the INV. (CH 1) NORM switch to NORM. Connect a 50-millivolt signal from the oscilloscope calibrator to the input of both channels. Set the MODE switch to CH 1; there should be 5 major divisions of vertical deflection. Turn the channel 1 VARIABLE VOLTS/DIV. control fully counterclockwise; there should be two (or less) major divisions of vertical deflection. Check to see that the UNCAL. neon is turned on. Return the Channel 1 VARIABLE VOLTS/DIV. control to CALIB.; the UNCAL. neon should turn off. Next, turn the MODE switch to CH 2 and repeat this check for the channel 2 VARIABLE VOLTS/DIV. control.

7. Check Alternate Mode Operation.

Set the MODE switch to ALTER. and position the two traces about two major divisions apart. Set the time-base plug-in for a sweep rate of 0.1 second/division and check to see that the trace alternates between channels 1 and 2.

8. Check Chopped Mode Operation.

Set the time-base plug-in for a sweep rate of 5 μsec/division and the Type 3A1 MODE switch to CHOP. The chopped trace on the crt should show about 1 sample for each major horizontal graticule division.

9. Check For Gassy Input Amplifier.

Set the VOLTS/DIV. switch to .02 and set the AC-DC-GND switch to GND then to AC. The trace should not shift vertically more than 1 minor graticule division.

10. Adjust Channel 1 and 2 Input Capacitance.

Connect the square-wave generator through the 5XT attenuator and the capacitance standardizer to the channel 1 input connector. Set the generator for a 1-kc ouput signal. Set the Channel 1 VOLTS/DIV. switch to .01. Set the generator output signal amplitude for 4 major graticule divisions of deflection and adjust C111 for an optimum flat-topped waveform. Set the VOLTS/DIV. switch to .02 and adjust C112 for an optimum flat-topped waveform. Remove the signal from channel 1 and connect it to channel 2. Set the channel 2 VOLTS/DIV. switch to .01 and adjust C211 for an optimum flat-topped waveform. Set the channel 2 VOLTS/DIV. switch to .02 and adjust C212 for an optimum flat-topped waveform.

11. Adjust Channel 1 and 2 VOLTS/DIV.

Switch Compensation Capacitors. Use the same test setup as in step 10. Adjust the square-wave generator for a 1-kc output signal with four major graticule divisions of amplitude. Perform the adjustments indicated in Table 6-1 for channel 1 and then connect

the square-wave generator to the channel 2 input connector and perform the adjustments for channel 2.

2. Adjust High-Frequency Compensation.

Connect the square-wave generator to channel 1. Set the generator output frequency for about 300 kc and adjust the amplitude for four major graticule divisions of vertical deflection. Set the time-base plug-in to display a single waveform. Adjust L361 and L371 (see Fig. 6-1) for optimum square corners without appreciable overshoot on the waveform.

TABLE 6-1

VOLTS/DIV. Switch Setting	Adjust for Optimum Square-Corner		Adjust for Optimum Flat-Top	
	Channel 1	Channel 2	Channel 1	Channel 2
.05	C103C	C203C	C103B	C203B
.1	C105C	C205C	C105B	C205B
.2	C107C	C207C	C107B	C207B
2	C109C	C209C	C109B	C209B

SECTION 7
PARTS LIST AND SCHEMATICS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

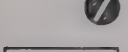
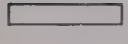
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

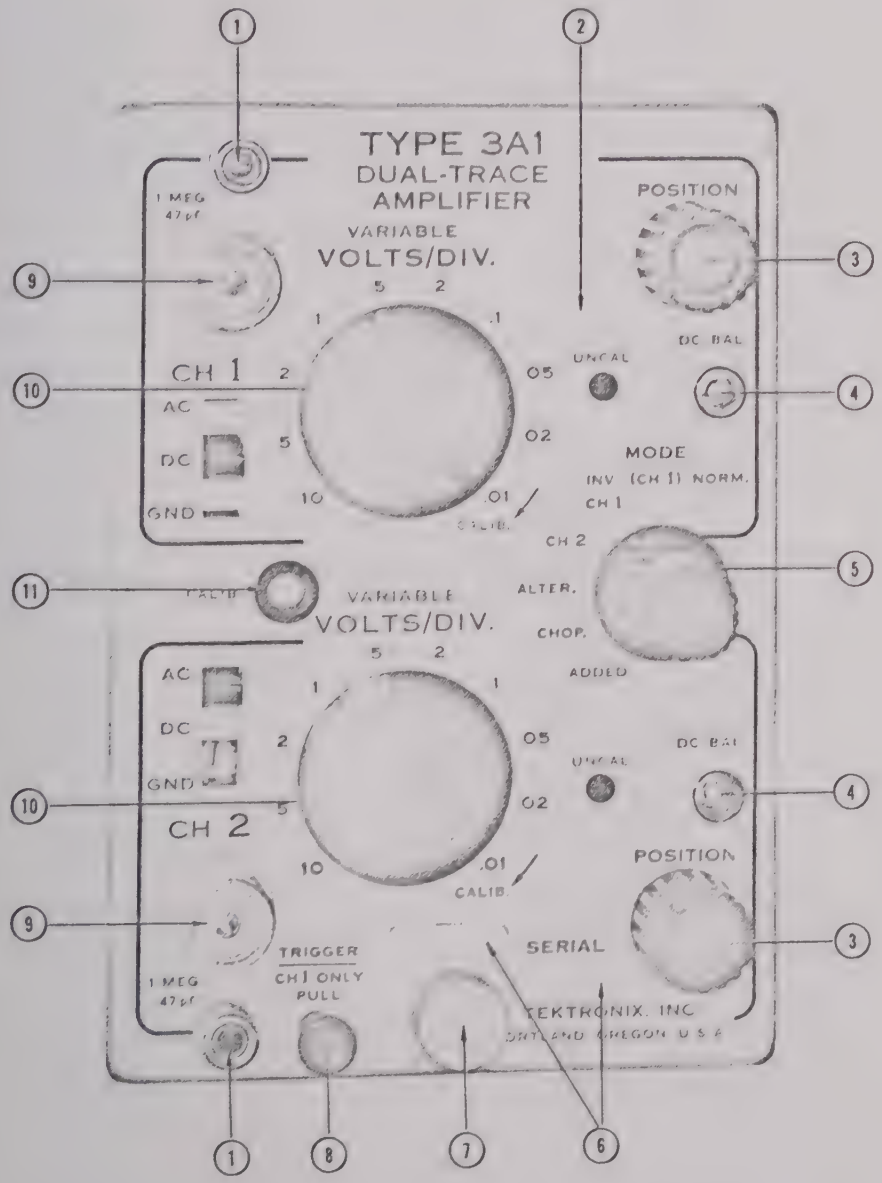
ABBREVIATIONS AND SYMBOLS

a or amp	amperes
BHS	binding head steel
C	carbon
cer	ceramic
cm	centimeter
comp	composition
cps	cycles per second
crt	cathode-ray tube
CSK	counter sunk
dia	diameter
div	division
EMC	electrolytic, metal cased
EMT	electroyltic, metal tubular
ext	external
f	farad
F & I	focus and intensity
FHS	flat head steel
Fil HS	fillister head steel
g or G	giga, or 10^9
Ge	germanium
GMV	guaranteed minimum value
h	henry
hex	hexagonal
HHS	hex head steel
HSS	hex socket steel
HV	high voltage
ID	inside diameter
incd	incandescent
int	internal
k or K	kilohms or kilo (10^3)
kc	kilocycle
m	milli, or 10^{-3}
mc	megacycle
mm	millimeter
meg or M	megohms or mega (10^6)
met.	metal
μ	micro, or 10^{-6}
n	nano, or 10^{-9}
Ω	ohm
OD	outside diameter
OHS	oval head steel
p	pico, or 10^{-12}
PHS	pan head steel
piv	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
Prec	precision
PT	paper tubular
PTM	paper or plastic, tubular, molded
RHS	round head steel
rms	root mean square
sec	second
Si	silicon
S/N	serial number
t or T	tera, or 10^{12}
TD	toroid
THS	truss head steel
tub.	tubular
v or V	volt
Var	variable
w	watt
w/	with
w/o	without
WW	wire-wound

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

FRONT


TYPE 3A1
DUAL-TRACE
AMPLIFIER
1 MEG
47pf
VARIABLE
VOLTS/DIV.
POSITION
DC BAL
UNCAL
CH 1
AC
DC
GND
MODE
INV (CH 1) NORM.
CH 1
CH 2
ALTER.
CHOP.
ADDED
CALIB.
TRIGGER
CH 1 ONLY
PULL
SERIAL
TEKTRONIX, INC.
1
2
3
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7
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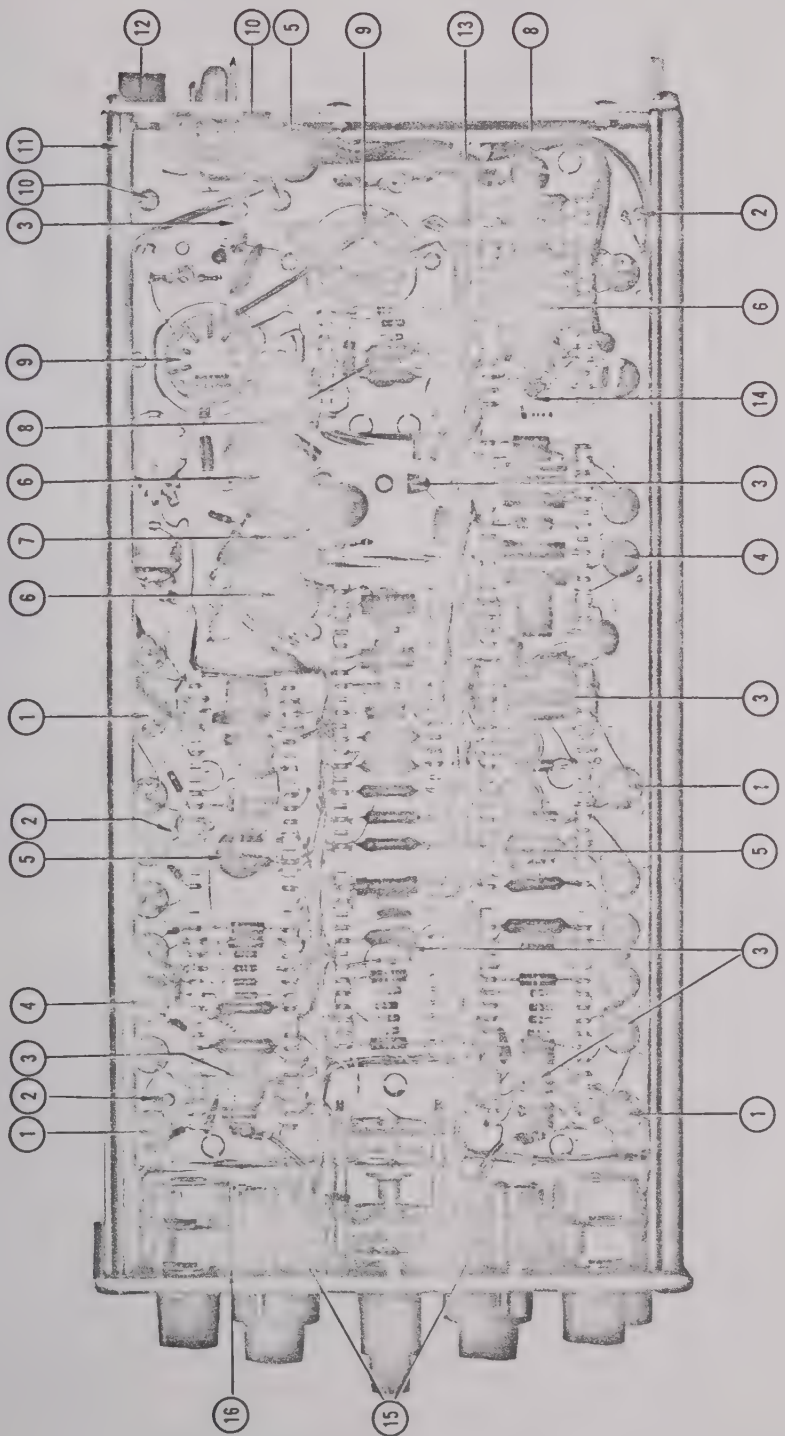
9
10
11

FRONT

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1.	129-035			2	POST, ground, assembly
					Each Consisting Of:
	355-507			1	STEM, adapter
	200-103			1	CAP
	210-011			1	LOCKWASHER
	210-455			1	NUT
2.	333-704	101	4327	1	PANEL, front
		4328		1	PANEL, front
	004-146			1	COVER, panel
3.	366-148			2	KNOB
	210-413			2	NUT
	210-840			2	WASHER
	210-012			2	LOCKWASHER
4.	358-075			2	BUSHING, pot mounting
5.	366-175	101	3349	1	KNOB, large
	366-250	3350			KNOB, large
	366-189	101	3349	1	KNOB, small
	366-140	3350			KNOB, small
	210-413			1	NUT
	210-012			1	LOCKWASHER
6.	334-679			2	TAG, metal serial no. insert
7.	366-109			1	KNOB, plug-in securing
8.	384-245	101	5049	1	ROD, extension, assembly w/molded knob
	384-304	5050		1	ROD, extension, assembly w/molded knob
9.	131-081			2	CONNECTOR, chassis mt., coaxial
	210-241			2	LUG, ground
10.	366-160			2	KNOB, large
	366-031			2	KNOB, small
	210-413			2	NUT
	210-012			2	LOCKWASHER
11.	358-178			1	BUSHING, front panel

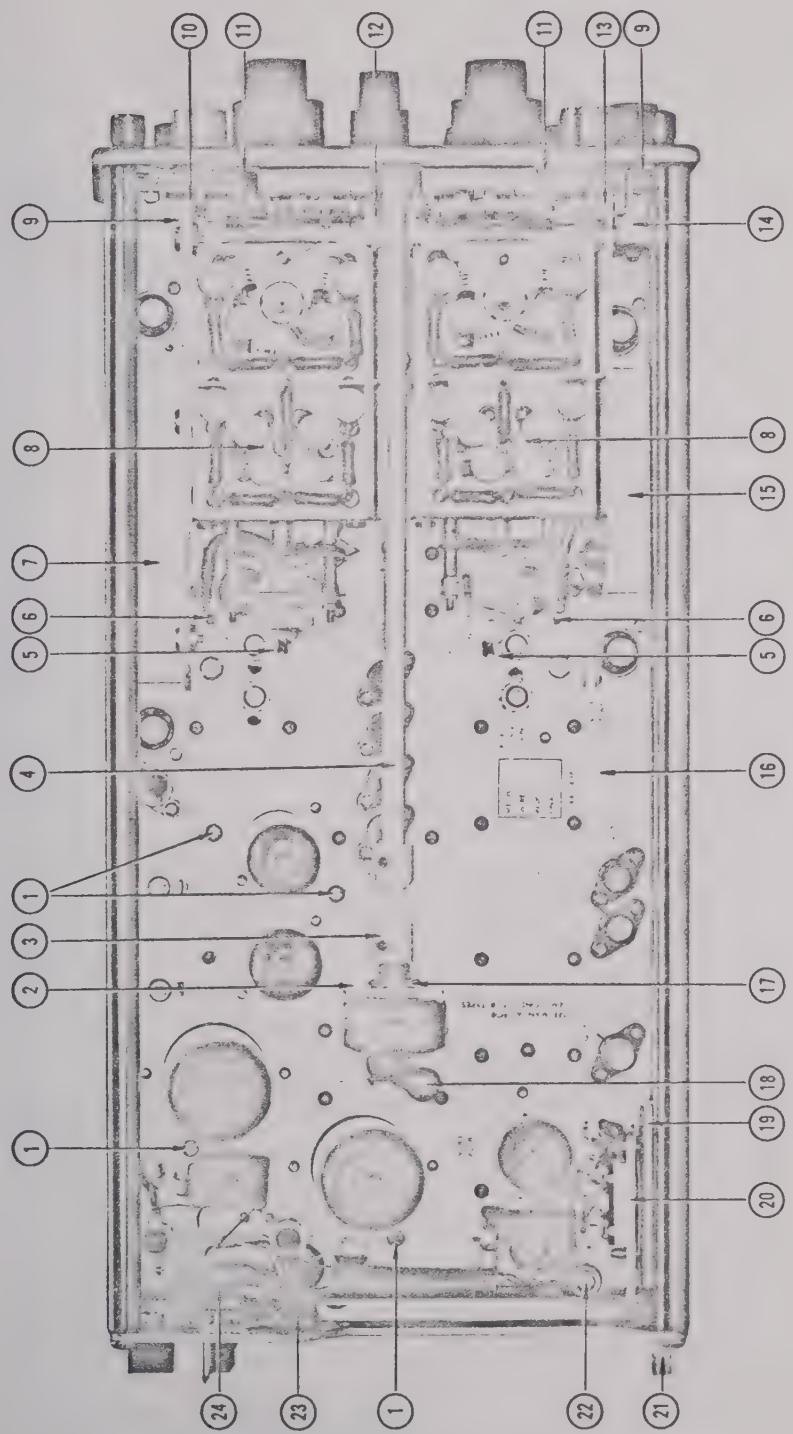
RIGHT SIDE



RIGHT SIDE

F. D.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
.	136-101			4	SOCKET, 5 pin
					Mounting Hardware For Each: (not included)
	213-055			2	SCREW, thread cutting
2.	210-215			3	LUG, banana, peewee
	213-055			3	SCREW, thread cutting
3.	210-201			6	LUG, solder
	213-044			6	SCREW, thread cutting
4	136-095			19	SOCKET, 4 pin transistor
					Mounting Hardware For Each: (not included)
	213-113			2	SCREW
5.	348-004			3	GROMMET
6.	136-015			3	SOCKET
					Mounting Hardware For Each: (not included)
	213-044			2	SCREW, thread cutting
7.	131-235			1	CONNECTOR, terminal bifurcated
	358-136			1	BUSHING
8.	348-003	101	4327	2	GROMMET
	348-031	4328		2	GROMMET
9.	136-126	101	2749	2	SOCKET, 9 pin
	136-114	2750		2	SOCKET, 9 pin
					Mounting Hardware For Each: (not included)
	213-044			2	SCREW, thread cutting
0.	213-054			2	SCREW, thread cutting
1.	384-566	101	4309	4	ROD, frame, spacing
	384-615	4310		4	ROD, fram, spacing
2.	214-276			2	SPRING, ground
	211-504			1	SCREW
	210-006			1	LOCKWASHER, int.
	210-407			1	NUT
3.	179-643			1	CABLE, harness
4.	426-121			1	MOUNT, toroid
	361-007			1	SPACER
5.	352-008	101	609	2	HOLDER, neon bulb, single
	352-053	610		2	HOLDER, neon bulb, single
					Mounting Hardware: (not included)
	211-031			1	SCREW
	210-406			2	NUT
6.	387-660			1	PLATE, front subpanel

LEFT SIDE



LEFT SIDE

F. O.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
.	213-035			4	SCREW, thread cutting
	210-201			1	LUG, solder
2.	406-814			1	BRACKET, pot
					Mounting Hardware: (not included)
	211-504			2	SCREW
3.	376-011			1	COUPLING, insulating
4.	384-246			1	ROD, extension
5.	210-223			2	LUG, solder
6.	131-183			2	CONNECTOR, terminal feed-thru
	358-136			2	BUSHING
7.	337-507			1	SHIELD
					Mounting Hardware: (not included)
	211-503			3	SCREW
8.	262-487	100	6939	2	SWITCH, wired, attenuator
	262-653	6940			SWITCH, wired, attenuator
					Each Includes:
	406-813	100	6939X	1	BRACKET, attenuator switch assembly
					Mounting Hardware:
	211-008	100	6939X	4	SCREW
	210-004	100	6939X	3	LOCKWASHER
	210-201	100	6939X	1	LUG, solder
	210-406	100	6939X	4	NUT
	337-505	100	6939	1	SHIELD
	337-680	6940		1	SHIELD
					Mounting Hardware:
	210-406			2	NUT
	210-004			2	LOCKWASHER, int.
	441-564			1	CHASSIS
	131-182			1	CONNECTOR, terminal feed-thru
	131-344			8	CONNECTOR
	358-135			1	BUSHING
	358-241			8	BUSHING
	214-456			10	FASTENER
9.	406-845			2	BRACKET, ground
					Mounting Hardware For Each: (not included)
	211-504			1	SCREW
	210-006			1	LOCKWASHER, int.
	210-407			1	NUT
10.	337-508	100	6939	1	SHIELD, top
	337-675	6940			SHIELD, top
					Mounting Hardware: (not included)
	211-504			2	SCREW
	210-406			4	NUT
11	337-510			1	SHIELD, middle
					Mounting Hardware: (not included)
	211-504			2	SCREW

LEFT SIDE *(Cont.)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
13.	337-509	100	6939	1	SHIELD, bottom
	337-676	6940		1	SHIELD, bottom
					Mounting Hardware: (not included)
	211-504			2	SCREW
14.	214-052			1	FASTENER, pawl right w/stop
					Mounting Hardware. (not included)
	210-406			2	NUT
	210-004			2	LOCKWASHER, int.
15	337-506			1	SHIELD, bottom box
					Mounting Hardware: (not included)
	211-503			2	SCREW
16.	441-436	101	4328	1	CHASSIS
	441-537	4329		1	CHASSIS
					Mounting Hardware: (not included)
	211-504			3	SCREW
	211-538			3	SCREW phillips
	210-006			3	LOCKWASHER
	210-407			3	NUT
17.	210-413			1	NUT
	210-840			1	WASHER
18.	211-544			1	SCREW, phillips
	210-478			1	NUT, resistor mounting
	211-507			1	SCREW
19.	406-802	101	5049	1	BRACKET, switch actuating
	406-447	5050			BRACKET, switch actuating
					Mounting Hardware: (not included)
	210-449			2	NUT
	210-006			1	LOCKWASHER
	210-202			1	LUG, solder
	213-105			2	SCREW, shoulder
20.	406-800			1	BRACKET, switch slide
					Mounting Hardware: (not included)
	211-504			2	SCREW
21.	351-037			1	GUIDE, plug-in
					Mounting Hardware: (not included)
	211-013			1	SCREW
	210-004			1	LOCKWASHER
	210-406			1	NUT
22.	211-553			1	SCREW, phillips
	210-601			1	EYELET
	210-478			1	NUT, resistor mounting
	211-507			1	SCREW
23.	387-647			1	PLATE, rear
					Mounting Hardware: (not included)
	212-044			4	SCREW
24.	131-149			1	CONNECTOR, chassis mount, 24 contact, male
					Mounting Hardware: (not included)
	211-008			2	SCREW
	210-201			2	LUG, solder
	210-406			2	NUT

ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description			S/N Range
		BULBS			
B113	150-027	Neon, NE-23			X1710-up
B150	Use 150-027	Neon, NE-23		UNCALIBRATED	
B213	150-027	Neon, NE-23			X1710-up
B250	Use 150-027	Neon, NE-23		UNCALIBRATED	
		CAPACITORS			
Tolerance ±20% unless otherwise indicated.					
Tolerance of all electrolytic capacitors as follows (with exceptions):					
3 V — 50 V = −10%, +250%					
51 V — 350 V = −10%, +100%					
351 V — 450 V = −10%, +50%					
C101	*285-609	.1 μf	MT	600 v 10%	
C103A	281-501	4.7 pf	Cer.	500 v ±1 pf	X6940-up
C103B	281-061	5.5-18 pf	Cer. Var.		101-6939
C103B	281-103	1.8-13 pf	Air Var.		6940-up
C103C	281-061	5.5 18 pf	Cer. Var.		101-6939
C103C	281-103	1.8-13 pf	Air Var.		6940-up
C103D	281-541	6.8 pf	Cer.	500 v 10%	X6940-up
C105A	281-501	4.7 pf	Cer.	500 v ±1 pf	X6940-up
C105B	281-061	5.5-18 pf	Cer. Var.		101-6939
C105B	281-103	1.8-13 pf	Air Var.		6940-up
C105C	281-060	2-8 pf	Cer. Var.		101-6939
C105C	281-101	1.5-9.1 pf	Air Var.		6940-up
C105E	281-503	8 pf	Cer.	500 v ±0.5 pf	
C107A	281-504	10 pf	Cer.	500 v 10%	101-6939
C107A	281-509	15 pf	Cer.	500 v 10%	6940-up
C107B	281-061	5.5-18 pf	Cer. Var.		101-6939
C107B	281-103	1.8-13 pf	Air Var.		6940-up
C107C	281-060	2-8 pf	Cer. Var.		101-6939
C107C	281-101	1.5-9.1 pf	Air Var.		6940-up
C107E	281-579	21 pf	Cer.	500 v	101-6939
C107E	281-513	27 pf	Cer.	500 v	6940-up
C109A	281-504	10 pf	Cer.	500 v 10%	101-6939
C109A	281-509	15 pf	Cer.	500 v 10%	6940-up
C109B	281-061	5.5-18 pf	Cer. Var.		101-6939
C109B	281-103	1.8-13 pf	Air Var.		6940-up
C109C	281-060	2-8 pf	Cer. Var.		101-6939
C109C	281-101	1.5-9.1 pf	Air Var.		6940-up
C109E	283-541	500 pf	Mica	500 v 10%	
C110	281-509	15 pf	Cer.	500 v 10%	X3075-up
C111	281-061	5.5-18 pf	Cer. Var.		101-6939
C111	281-103	1.8-13 pf	Air Var.		6940-up

CAPACITORS *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description				S/N Range
C112	281-060	2-8 pf	Cer.	Var.		101-6939
C112	281-101	1.5-9.1 pf	Air	Var.		6940-up
C113	283-068	.01 μf	Disc Type	500 v		
C114	281-500	2.2 pf	Cer.	500 v	±0.5 pf	X3075-up
C115	Use 283-057	.1 μf	Disc Type	200 v		
C123	283-003	.01 μf	Disc Type	150 v		
C125	283-003	.01 μf	Disc Type	150 v		
C137	281-549	68 pf	Cer.	500 v	10%	
C167	281-524	150 pf	Cer.	500 v		
C185	281-543	270 pf	Cer.	500 v	10%	
C187	281-528	82 pf	Cer.	500 v	10%	
C201	*285-609	.1 μf	MT	600 v	10%	
C203A	281-501	4.7 pf	Cer.	500 v	±1 pf	X6940-up
C203B	281-061	5.5-18 pf	Cer.	Var.		101-6939
C203B	281-103	1.8-13 pf	Air	Var.		6940-up
C203C	281-061	5.5-18 pf	Cer.	Var.		101-6939
C203C	281-103	1.8-13 pf	Air	Var.		6940-up
C203D	281-541	6.8 pf	Cer.	500 v	10%	X6940-up
C205A	281-501	4.7 pf	Cer.	500 v	±1 pf	X6940-up
C205B	281-061	5.5-18 pf	Cer.	Var.		101-6939
C205B	281-103	1.8-13 pf	Air	Var.		6940-up
C205C	281-060	2-8 pf	Cer.	Var.		101-6939
C205C	281-101	1.5-9.1 pf	Air	Var.		6940-up
C205E	281-503	8 pf	Cer.	500 v	±0.5 pf	
C207A	281-504	10 pf	Cer.	500 v	10%	101-6939
C207A	281-509	15 pf	Cer.	500 v	10%	6940-up
C207B	281-061	5.5-18 pf	Cer.	Var.		101-6939
C207B	281-103	1.8-13 pf	Air	Var.		6940-up
C207C	281-060	2-8 pf	Cer.	Var.		101-6939
C207C	281-101	1.5-9.1 pf	Air	Var.		6940-up
C207E	281-579	21 pf	Cer.	500 v	5%	101-6939
C207E	281-513	27 pf	Cer.	500 v		6940-up
C209A	281-504	10 pf	Cer.	500 v	10%	101-6939
C209A	281-509	15 pf	Cer.	500 v	10%	6940-up
C209B	281-061	5.5-18 pf	Cer.	Var.		101-6939
C209B	281-103	1.8-13 pf	Air	Var.		6940-up
C209C	281-060	2-8 pf	Cer.	Var.		101-6939
C209C	281-101	1.5-9.1 pf	Air	Var.		6940-up
C209E	283-541	500 pf	Mica	500 v	10%	
C210	281-509	15 pf	Cer.	500 v	10%	X3075-up
C211	281-061	5.5-18 pf	Cer.	Var.		101-6939
C211	281-103	1.8-13 pf	Air	Var.		6940-up
C212	281-060	2-8 pf	Cer.	Var.		101-6939
C212	281-101	1.5-9.1 pf	Air	Var.		6940-up
C213	283-068	.01 μf	Disc Type	500 v		

Capacitors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
C214	281-500	2.2 pf	Cer.	500 v	±0.5 pf	X3075-up
C215	Use 283-057	.1 μf	Disc Type	200 v		
C223	283-003	.01 μf	Disc Type	150 v		
C225	283-003	.01 μf	Disc Type	150 v		
C237	281-549	68 pf	Cer.	500 v	10%	
C260	283-067	.001 μf	Disc Type	200 v	10%	101-7069
C260	283-104	2000 pf	Disc Type	500 v	5%	7070-up
C261	281-523	100 pf	Cer.	350 v		
C263	283-003	.01 μf	Disc Type	150 v		
C266	281-513	27 pf	Cer.	500 v		
C268	283-003	.01 μf	Disc Type	150 v		
C277	281-523	100 pf	Cer.	350 v		
C287	281-523	100 pf	Cer.	350 v		
C291	283-003	.01 μf	Disc Type	150 v		
C307	283-003	.01 μf	Disc Type	150 v		
C327	283-000	.001 μf	Disc Type	500 v		
C340	283-002	.01 μf	Disc Type	500 v		
C360	283-006	.02 μf	Disc Type	600 v		
C366	283-002	.01 μf	Disc Type	500 v		
C369	283-002	.01 μf	Disc Type	500 v		
C373	281-526	1.5 pf	Cer.	500 v	±0.5 pf	
C376	283-002	.01 μf	Disc Type	500 v		
C378	283-026	.2 μf	Disc Type	25 v		
C381	281-526	1.5 pf	Cer.	500 v	±0.5 pf	
C385	283-003	.01 μf	Disc Type	150 v		
C387	281-528	82 pf	Cer.	500 v	10%	
C391	283-003	.01 μf	Disc Type	150 v		
C395	283-026	.2 μf	Disc Type	25 v		
C396	Use 290-134	22 μf	EMT	15 v		
C397	283-003	.01 μf	Disc Type	150 v		
C398	283-003	.01 μf	Disc Type	150 v		
C399	283-006	.02 μf	Disc Type	600 v		

Diodes

D130	152-008	Germanium	T12G	
D131	152-008	Germanium	T12G	
D132	152-008	Germanium	T12G	X1710-up
D140	152-008	Germanium	T12G	
D155	152-071	Germanium	ED2007	
D156	152-071	Germanium	ED2007	
D157	152-071	Germanium	ED2007	
D158	152-071	Germanium	ED2007	
D230	152-008	Germanium	T12G	
D231	152-008	Germanium	T12G	
D232	152-008	Germanium	T12G	X1710-up
D240	152-008	Germanium	T12G	

Diodes *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description		S/N Range
D255	152-071	Germanium	ED2007	
D256	152-071	Germanium	ED2007	
D257	152-071	Germanium	ED2007	
D258	152-071	Germanium	ED2007	
D263	*152-061		Tek Spec	X8570-up
D278	*152-075	Germanium	Tek Spec	
D288	152-075	Germanium	Tek Spec	
D337	152-071	Germanium	ED2007	101-6729X
D338	152-071	Germanium	ED2007	101-6729X
D345	*152-075	Germanium	Tek Spec	
D355	*152-075	Germanium	Tek Spec	
D365	152-071	Germanium	ED2007	101-4327X
D366	152-071	Germanium	ED2007	101-4327X
D378	152-024	Zener	15 v 1 w 5%	
D397	152-057	Zener	56 v 1.5 w 5%	

Inductors

LR103	*108-283	.13 μh				X6940-up
LR105	*108-286	.17 μh				X6940-up
LR107	*108-283	.13 μh				X6940-up
LR203	*108-283	.13 μh				X6940-up
LR205	*108-286	.17 μh				X6940-up
LR207	*108-283	.13 μh				X6940-up
L315	*108-147	2.2 μh				
L326	*108-253	7.8 μh				
L336	*108-253	7.8 μh				
L341	*108-147	2.2 μh				
L344	*108-072	.75 μh				101-4327X
L345	276-507	Ferramic Suppressor				101-4327X
L351	*108-147	2.2 μh				
L354	*108-072	.75 μh				101-4327X
L355	276-507	Ferramic Suppressor				101-4327X
L361	*114-151	35-50 μh	Var.	Core 276-511		
L363	*108-252	3.6 μh				
L371	*114-151	35-50 μh	Var.	Core 276-511		
L373	*108-252	3.6 μh				
L378	*108-200	40 μh				
L396	*108-016	29 μh				

RESISTORS

Resistors are fixed, composition, ±10% unless otherwise indicated.

R101	302-100	10 Ω	½ w		
R103C	Use 322-643	600 k	¼ w	Prec.	1%
R103E	Use 322-644	666.6 k	¼ w	Prec.	1%
R105C	Use 322-620	800 k	¼ w	Prec.	1%
R105E	Use 322-614	250 k	¼ w	Prec.	1%

RESISTORS *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description				S/N Range
R107C	Use 322-621	900 k	¼ w	Prec.	1%	
R107E	Use 322-608	111 k	¼ w	Prec.	1%	
R109A	315-101	100 Ω	¼ w		5%	X6940-up
R109C	Use 322-624	990 k	¼ w	Prec.	1%	
R109D	315-510	51 Ω	¼ w		5%	X6940-up
R109E	Use 322-605	10.1 k	¼ w	Prec.	1%	
R109F	316-150	15 Ω	¼ w			
R110	315-100	10 Ω	¼ w		5%	101-6939
R110	315-470	47 Ω	¼ w		5%	6940-up
R111	Use 322-481	1 meg	¼ w	Prec.	1%	101-6939
R113	315-105	1 meg	¼ w		5%	
R114	316-101	100 Ω	¼ w			
R115	302-221	220 Ω	½ w			
R116	301-392	3.9 k	½ w		5%	101-4327
R116	301-562	5.6 k	½ w		5%	4328-up
R119	311-321	2 x 500 k		Var.	DC BAL	
R120	Use 316-335	3.3 meg	¼ w			
R121	316-274	270 k	¼ w			
R123	316-182	1.8 k	¼ w			
R124	316-101	100 Ω	¼ w			
R125	316-101	100 Ω	¼ w			
R126	301-392	3.9 k	½ w		5%	101-4327
R126	301-562	5.6 k	½ w		5%	4328-up
R133	301-431	430 Ω	½ w		5%	
R134	315-391	390 Ω	¼ w		5%	
R135	309-117	2.1 k	½ w	Prec.	1%	
R137	316-470	47 Ω	¼ w			
R138	315-391	390 Ω	¼ w		5%	
R139†	*311-319	375 Ω		Var.	VARIABLE	
R142	309-028	1.48 k	½ w	Prec.	2%	
R143	301-431	430 Ω	½ w		5%	
R144	315-391	390 Ω	¼ w		5%	
R145	309-117	2.1 k	½ w	Prec.	1%	
R147	311-258	100 Ω		Var.	20 MV GAIN	
R148	316-680	68 Ω	¼ w			
R149	311-258	100 Ω		Var.	10 MV GAIN	
R150	316-104	100 k	¼ w			
R151	302-683	68 k	½ w			
R152	301-163	16 k	½ w		5%	
R153	311-114	2 x 250 k		Var.	POSITION	
R154	302-683	68 k	½ w			
R164	315-622	6.2 k	¼ w		5%	
R167	315-820	82 Ω	¼ w		5%	
R170	316-221	220 Ω	¼ w			
R171	311-159	20 k		Var.	TRIG. DC LEVEL	

† R139 ganged with SW150. Furnished as a unit.

©

RESISTORS *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description				S/N Range
R172	316-333	33 k	¼ w			
R173	301-152	1.5 k	½ w		5%	
R174	315-622	6.2 k	¼ w		5%	
R175	315-513	51 k	¼ w		5%	
R176	316-332	3.3 k	¼ w			
R184	301-332	3.3 k	½ w		5%	
R185	315-151	150 Ω	¼ w		5%	
R187	316-473	47 k	¼ w			
R188	316-105	1 meg	¼ w			
R201	302-100	10 Ω	½ w			
R203C	Use 322-643	600 k	¼ w	Prec.	1%	
R203E	Use 322-644	666.6 k	¼ w	Prec.	1%	
R205C	Use 322-620	800 k	¼ w	Prec.	1%	
R205E	Use 322-614	250 k	¼ w	Prec.	1%	
R207C	Use 322-621	900 k	¼ w	Prec.	1%	
R207E	Use 322-608	111 k	¼ w	Prec.	1%	
R209A	315-101	100 Ω	¼ w		5%	X6940-up
R209C	Use 322-624	990 k	¼ w	Prec.	1%	
R209D	315-510	51 Ω	¼ w		5%	X6940-up
R209E	Use 322-605	10.1 k	¼ w	Prec.	1%	
R209F	316-150	15 Ω	¼ w			
R210	315-100	10 Ω	¼ w		5%	101-6939
R210	315-470	47 Ω	¼ w		5%	6940-up
R211	Use 322-481	1 meg	¼ w	Prec.	1%	
R213	315-105	1 meg	¼ w		5%	
R214	316-101	100 Ω	¼ w			
R215	302-221	220 Ω	½ w			
R216	301-392	3.9 k	½ w		5%	101-4327
	301-562	5.6 k	½ w		5%	4328-up
R219	311-321	2 x 500 k		Var.	DC BAL	
R220	Use 316-335	3.3 meg	¼ w			
R221	316-274	270 k	¼ w			
R223	316-182	1.8 k	¼ w			
R224	316-101	100 Ω	¼ w			
R225	316-101	100 Ω	¼ w			
R226	301-392	3.9 k	½ w		5%	101-4327
R226	301-562	5.6 k	½ w		5%	4328-up
R233	301-431	430 Ω	½ w		5%	
R234	315-391	390 Ω	¼ w		5%	
R235	309-117	2.1 k	½ w	Prec.	1%	
R237	316-470	47 Ω	¼ w			
R238	315-391	390 Ω	¼ w		5%	
R239†	*311-319	375 Ω		Var.	VARIABLE	
R242	309-028	1.48 k	½ w		2%	
R243	301-431	430 Ω	½ w		5%	

† R239 ganged with SW250. Furnished as a unit.

RESISTORS (Cont'd)

Ckt. No.	Tektronix Part No.		Description				S/N Range
R244	315-391	390 Ω	¼ w			5%	
R245	309-117	2.1 k	½ w		Prec.	1%	
R247	311-258	100 Ω		Var.		20 MV GAIN	
R248	316-680	68 Ω	¼ w				
R249	311-258	100 Ω		Var.		10 MV GAIN	
R250	316-104	100 k	¼ w				
R251	302-683	68 k	½ w				
R252	301-163	16 k	½ w			5%	
R253	311-114	2 x 250 k		Var.		POSITION	
R254	302-683	68 k	½ w				
R260	316-222	2.2 k	¼ w				101-7069
R260	316-102	1 k	¼ w				7070-up
R261	302-153	15 k	½ w				101-8569
R261	302-103	10 K	½ w				8570-up
R263	302-470	47 Ω	½ w				
R265	301-223	22 k	½ w			5%	
R266	301-183	18 k	½ w			5%	
R268	316-101	100 Ω	¼ w				
R271	302-103	10 k	½ w				
R273	301-202	2 k	½ w			5%	
R275	301-202	2 k	½ w			5%	
R276	309-121	9.5 k	½ w		Prec.	1%	
R277	318-099	3 k	⅛ w		Prec.	1%	
R278†	Use 309-407	400 Ω	½ w		Prec.	½%	
R279	302-561	560 Ω	½ w				
R285	301-202	2 k	½ w			5%	
R286	309-121	9.5 k	½ w		Prec.	1%	
R287	318-099	3 k	⅛ w		Prec.	1%	
R288†	Use 309-407	400 Ω	½ w		Prec.	½%	
R289	302-561	560 Ω	½ w				
R291	302-100	10 Ω	½ w				
R292	315-152	1.5 k	¼ w			5%	
R293	309-274	1.4 k	½ w		Prec.	1%	
R294	309-274	1.4 k	½ w		Prec.	1%	
R304	309-097	600 Ω	½ w		Prec.	1%	
R306	309-078	343 Ω	½ w		Prec.	1%	
R307	309-273	866 Ω	½ w		Prec.	1%	
R314	309-097	600 Ω	½ w		Prec.	1%	
R315	301-120	12 Ω	½ w			5%	
R322	301-511	510 Ω	½ w			5%	
R323	315-751	750 Ω	¼ w			5%	
R325	316-470	47 Ω	¼ w				
R326	309-158	1.19 k	½ w		Prec.	1%	
R327	Use 302-681	680 Ω	½ w				
R328	311-323	1.5 k		Var.	WW	OUTPUT DC LEVEL	
R329	303-203	20 k	½ w			5%	
R333	315-751	750 Ω	¼ w			5%	

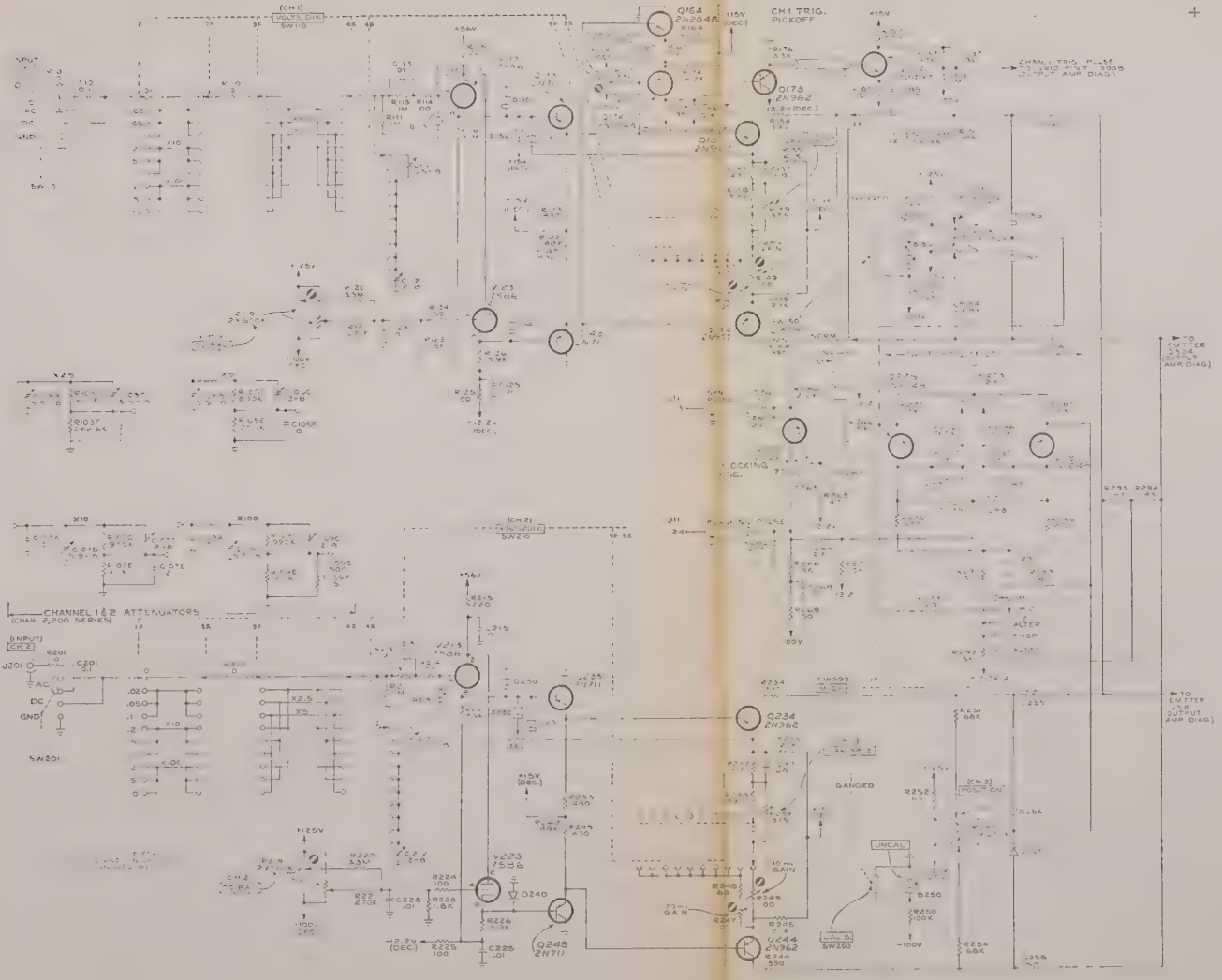
† S/N 101-1359, R278 and R288 have to be replaced at the same time.

RESISTORS (Cont'd)

Ckt. No.	Tektronix Part No.		Description				S/N Range
R335	316-470	47 Ω	¼ w				
R336	309-158	1.19 k	½ w		Prec.	1%	
R337	316-101	100 Ω	¼ w				
R339	303-203	20 k	½ w			5%	
R340	302-102	1 k	½ w				101-4327
R340	308-077	1 k	3 w		WW		4328-up
R341	316-470	47 Ω	¼ w				
R346	316-470	47 Ω	¼ w				X4328-up
R347	301-622	6.2 k	½ w			5%	
R351	316-470	47 Ω	¼ w				
R356	316-470	47 Ω	¼ w				X4328-up
R357	301-622	6.2 k	½ w			5%	
R360	308-089	1 k	10 w		WW	5%	101-4327
R360	308-289	820 Ω	10 w		WW	5%	4328-up
R361	*310-596	1.5 k	8 w		Prec.	1%	
R364	316-220	22 Ω	¼ w				101-4327
R364	321-101	110 Ω	⅛ w		Prec.	1%	4328-up
R366	302-274	270 k	½ w				
R367	309-344	100 Ω	½ w		Prec.	1%	
R368	305-620	62 Ω	2 w			5%	X4328-up
R369	316-470	47 Ω	¼ w				
R371	*310-596	1.5 k	8 w		Prec.	1%	
R374	311-308	50 Ω	2 w	Var.		CALIB.	101-4327
R374	311-383	150 Ω	2 w	Var.		CALIB.	4328-up
R376	302-274	270 k	½ w				
R377	309-344	100 Ω	½ w		Prec.	1%	
R378	308-232	320 Ω	5 w		WW	5%	101-4327
R378	308-251	256 Ω	5 w		WW	5%	4328-up
R381	309-055	370 k	½ w		Prec.	1%	101-4327
	323-441	383 k	½ w		Prec.	1%	4328-up
R382	309-243	193 k	½ w		Prec.	1%	101-4327
R382	323-412	191 k	½ w		Prec.	1%	4328-up
R384	316-101	100 Ω	¼ w				
R385	316-471	470 Ω	¼ w				
R387	302-473	47 k	½ w				
R389	306-123	12 k	2 w				
R390	316-101	100 Ω	¼ w				
R391	316-471	470 Ω	¼ w				
R392	302-473	47 k	½ k				
R393	306-102	1 k	2 w				X7930-up
R394	307-034	8.2 Ω	½ w				
R395	307-034	8.2 Ω	½ w				
R397	308-230	2.7 k	3 w		WW	5%	
R398	316-270	27 Ω	¼ w				

SWITCHES

	Unwired	Wired			
SW101	260-448		Slide		
SW110	260-441	Use *262-653	Rotary	VOLTS/DIV	101-6939
SW110	260-607	*262-653	Rotary		6940-up
SW150†	*311-319			CALIBRATED	
SW155††	260-442		Rotary	INV/NORM	



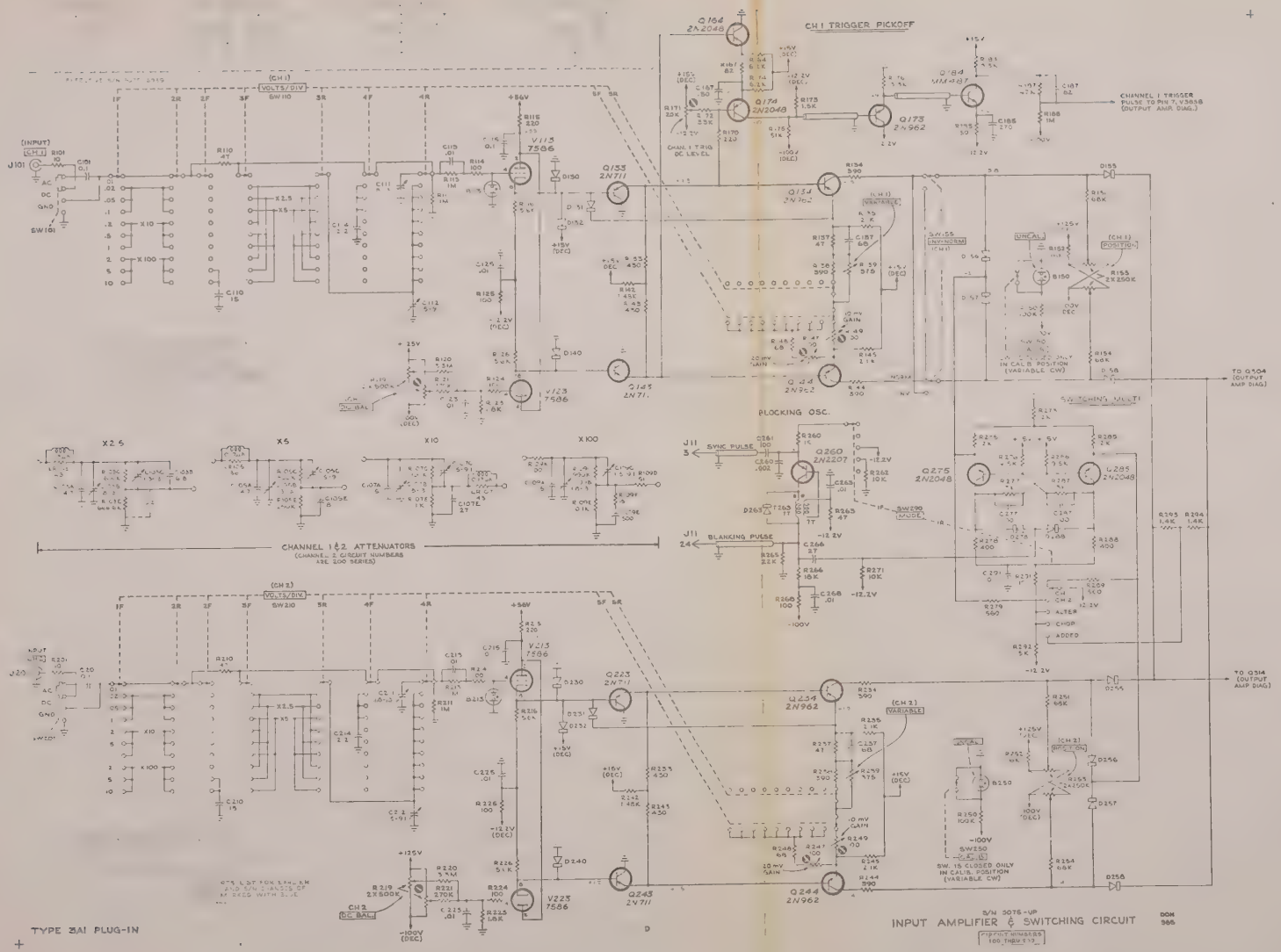
+ TYPE 3A1 PLUG-IN

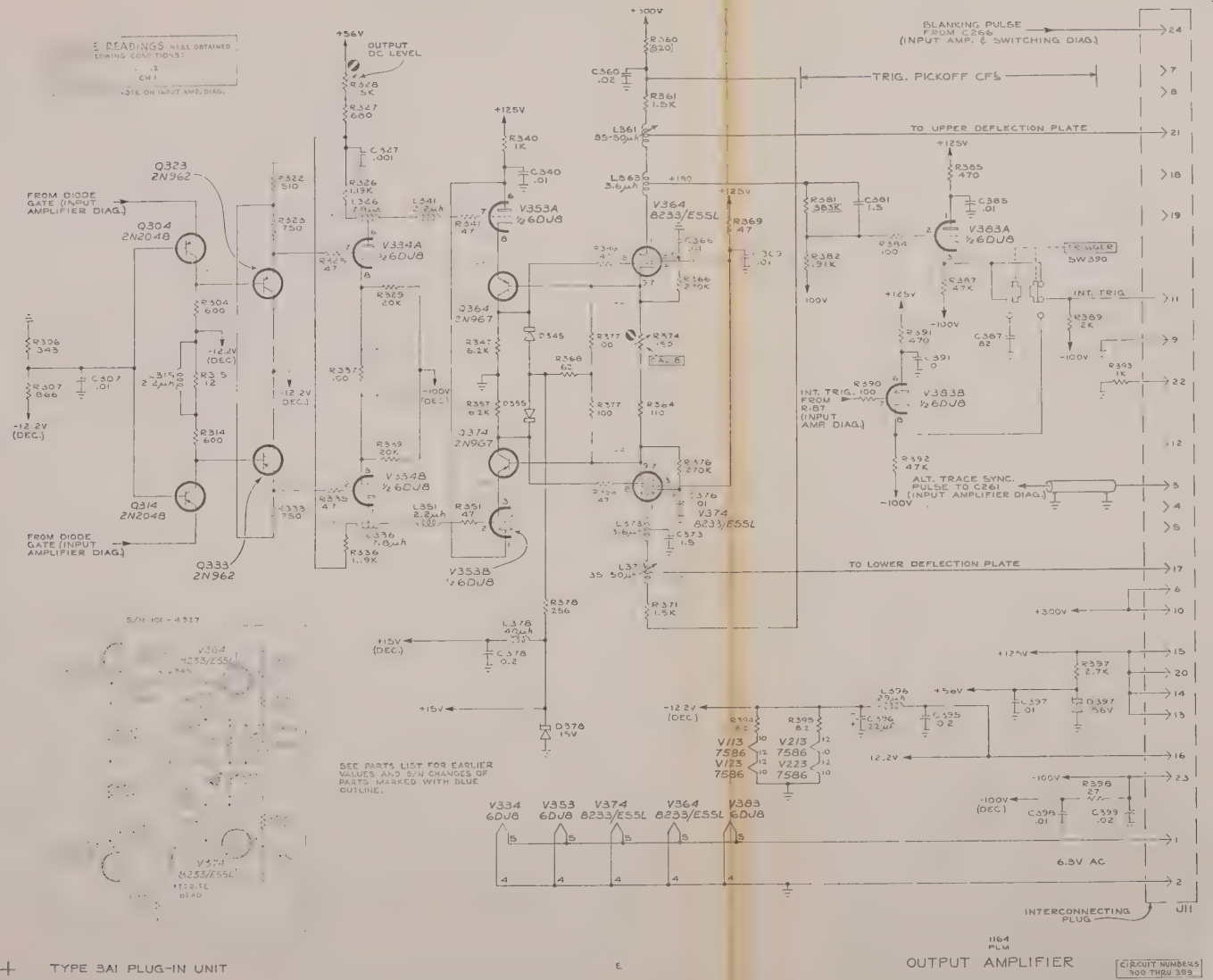
S/N 101 - 2074

INPUT AMPLIFIER & SWITCHING CIRCUIT

CIRCUIT NUMBERS 100 THRU 299

8.


CH 1 TRIGGER PICKOFF
CHANNEL 1 TRIGGER PULSE TO PIN 7, V303B (OUTPUT AMP DIAG.)
CHANNEL 1 TRIG. DC LEVEL
BLOCKING OSC.
SYNC PULSE
BLANKING PULSE
SWITCHING MULTI
CHANNEL 1 & 2 ATTENUATORS
(CHANNEL 2 CIRCUIT NUMBERS ARE 200 SERIES)
TO Q304 (OUTPUT AMP DIAG.)
TO Q314 (OUTPUT AMP DIAG.)
CH 1 VOLTS/DIV SW110
CH 2 VOLTS/DIV SW210
CH 1 VARIABLE
CH 2 VARIABLE
CH 1 POSITION
CH 2 POSITION
CH 1 DC BAL
CH 2 DC BAL
IN CALIB POSITION (VARIABLE CW)
SW. IS CLOSED ONLY IN CALIB. POSITION (VARIABLE CW)
ALTER
CHOP
ADDED
TYPE 3A1 PLUG-IN
S/N 3076-UP
INPUT AMPLIFIER & SWITCHING CIRCUIT
DOK 565



1164 PLM

OUTPUT AMPLIFIER

CIRCUIT NUMBERS 300 THRU 399

+ TYPE 3A1 PLUG-IN UNIT

E

OUTPUT AMPLIFIER

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

INSTRUCTION MANUAL

Serial Number

MODIFICATION INSERT

TYPE 3B3
MOD 236J

This insert has been written to supplement the Instruction Manual furnished with this modified instrument. The information given in this insert will supersede that given in the manual.

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Type 3B3

Plug-in Unit

MOD 236J

ektronix, Inc.
S.W. Millikan Way • P. O. Box 500 • Beaverton, Oregon • Phone MI 4-0161 • Cables: Tektronix

ektronix International A.G.
Terrassenweg 1A • Zug, Switzerland • PH. 042-49192 • Cable: Tekintag, Zug Switzerland • Telex 53 [illegible]

08105

ds

TYPE 3S3
MOD 236J

The Plug-In unit for which this insert was prepared has been modified to provide the following:

The front panel control knobs have been changed to ones with black matte finish. The Front Panel has been changed to a special panel finished by Photo Chemical Products.

The [illegible] from the front panel to the [illegible]

[illegible]

[illegible]

[illegible]			390-0455-[illegible]
[illegible]			175-[illegible]
[illegible]			136-[illegible]
[illegible], Duo (331-[illegible], Blk Matte	Change	1	[illegible]
[illegible], Delrin Connector	Add	1	[illegible]
[illegible] (366-0085-00), Black Matte	Change	1	[illegible]
KNOB ([illegible]-0175-00), Black Matte	Change	1	[illegible]-304[illegible]
KNOB ([illegible]-0191-00), Black Matte	Change	2	036-3050-[illegible]
KNOB ([illegible]-0211-00), Black Matte	Change	1	036-3051-[illegible]
KNOB ([illegible]-0215-00), Black Matte	Change	7	036-3052-[illegible]
KNOB ([illegible]-0241-00), Black Matte	Change	1	036-3057-[illegible]
PANEL, Front	Change	1	334-0039-[illegible]
POST, Delrin, 2-hole	Add	1	385-0113-[illegible]
POST, Delrin, 4-hole	Add	1	385-0138-[illegible]
RIVET, Pop (MFD)	Add	4	13-1030-[illegible]
TAG, I.D. and Serial, Fill-[illegible]	Add	[illegible]	334-0040-[illegible]

[illegible]

SCHEMATIC

INSTRUCTION MANUAL

Serial Number _____

Type 3B3

Plug-In Unit

Tektronix, Inc.
S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon ● Phone MI 4-0161 ● Cables: Tektronix

070-365

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.

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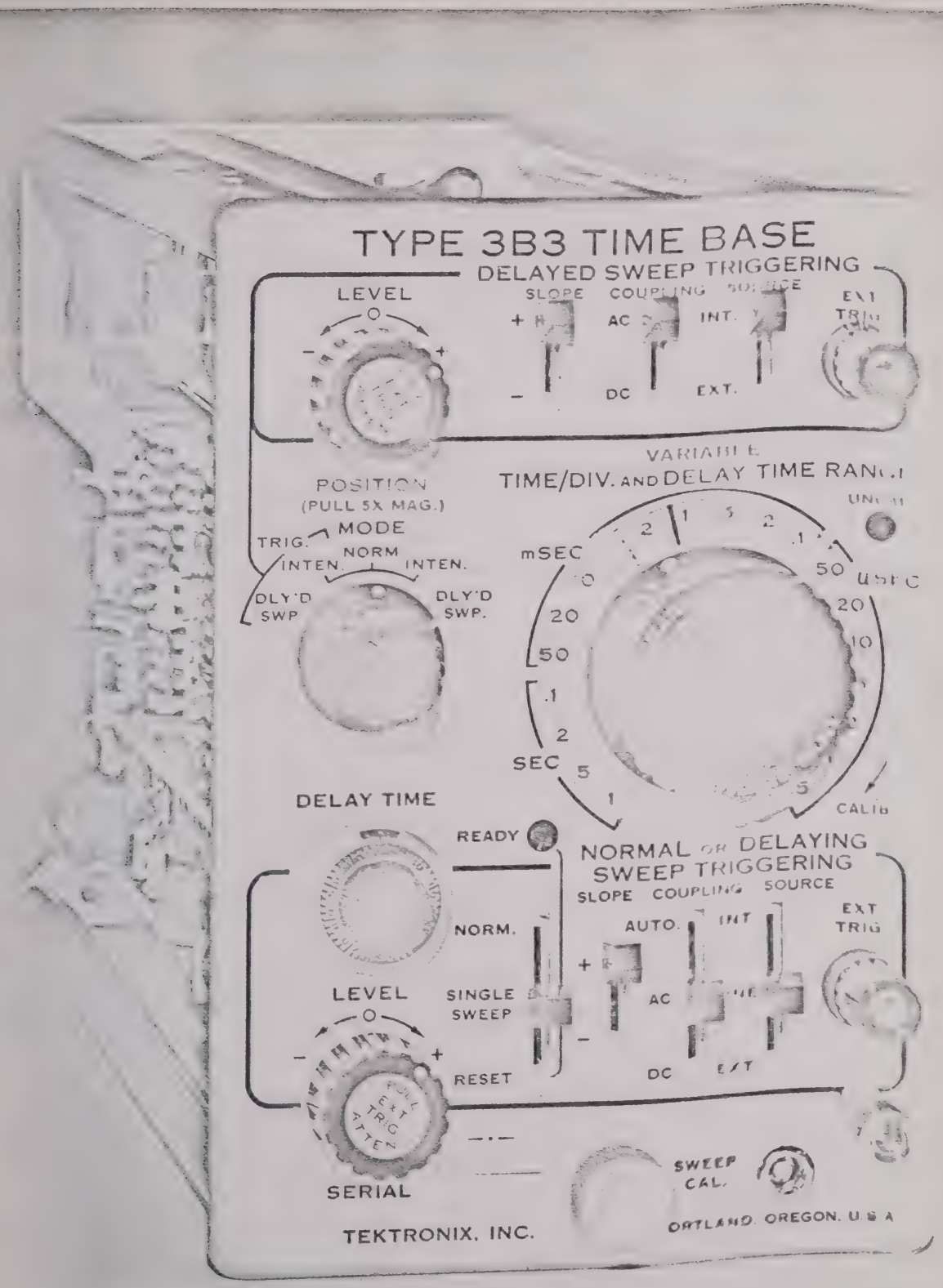
CONTENTS

	Warranty
Section 1	Characteristics
Section 2	Operating Instructions
Section 3	Applications
Section 4	Circuit Description
Section 5	Maintenance
Section 6	Calibration
Section 7	Parts List and Diagram


TYPE 3B3 TIME BASE
DELAYED SWEEP TRIGGERING
LEVEL
SLOPE
COUPLING
SOURCE
EXT TRIG
AC
DC
INT.
EXT.
POSITION
(PULL 5X MAG.)
MODE
TRIG.
NORM
INTEN.
INTEN.
DLY'D SWP
DLY'D SWP.
VARIABLE
TIME/DIV. AND DELAY TIME RANGE
UNCAL
mSEC
SEC
μSEC
50
20
10
5
2
1
.5
.2
.1
CALIB
DELAY TIME
READY
NORMAL OR DELAYING
SWEEP TRIGGERING
SLOPE
COUPLING
SOURCE
AUTO.
INT
EXT TRIG
NORM.
SINGLE SWEEP
RESET
LEVEL
AC
DC
EXT
SERIAL
SWEEP CAL.
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

SECTION 1

CHARACTERISTICS

General

The Type 3B3 Time Base Unit is a plug-in time base generator designed for use with Tektronix Types 561A, RM561A, 564, 567 and RM567 Oscilloscopes. The Type 3B3 provides normal or delayed sweeps at 20 calibrated rates from 0.5 microseconds per division to 1 second per division. In delayed sweep operation, the Type 3B3 gives continuous calibrated sweep delay from 0.5 microsecond to 10 seconds after receipt of a triggering impulse.

Sweep Rates

Both normal and delayed sweep rates from 0.5 microsecond per division to 1 second per division in 20 calibrated steps. A variable control provides uncalibrated sweep rates between steps and also extends the slower rate to approximately 2.5 seconds per division. Calibrated sweep rates for both normal and delayed sweeps are typically within 1%, and in all cases within 3% of the TIME/DIV. and DELAY TIME RANGE switch settings.

Sweep Magnification

The display can be magnified 5 times, extending both the normal and delayed sweep rates to 0.1 microsecond per division. Sweep rate accuracy with the 5X magnification remains within 5% of the TIME/DIV. and DELAY TIME RANGE switch settings.

Sweep Delay

The calibrated sweep delay is continuously variable from 0.5 microsecond to 10 seconds. Delay accuracy is 1% of full scale reading, and delay time linearity is within 0.2% of full scale from 5 microseconds to 2 seconds of delay. Time jitter is less than 1 part in 20,000 of the maximum available delay interval.

Single Sweep

All modes of operation can be displayed as a single sweep for photographic recording.

Triggering Modes, Normal Sweep

Automatic (15 cps to 10 mcs), ac- or dc-coupled, + or − slope, internal or external source.

Triggering Modes, Delayed Sweep

Ac- or dc-coupled, + or — slope, internal or external source.

Internal Triggering Requirements, Either Time Base

Internal triggering with signals in the frequency range from dc to 5 mc requires a trigger amplitude of 0.2 major divisions of vertical deflection. Above 5 mc, the trigger requirements increase, and at 10 mc, a trigger amplitude of 0.5 major division of vertical deflection is required.

External Triggering Requirements, Either Time Base

External triggering with signals in the frequency range from dc to 5 mc requires a trigger amplitude of 0.5 volts. Above 5 mc the trigger requirements increase and at 10 mc, a trigger amplitude of 1.25 volts is required. Maximum triggering signal is 15 volts direct, or 150 volts through internal attenuator (operated by front panel switch). If ac coupling is used, up to 500 volts total, dc and ac peak combined, may be applied so long as the ac component does not exceed 150 volts.

Construction

Aluminum-alloy chassis. Front panel photo-etched and anodized.

Weight

5 pounds 4 ounces.

NOTES

SECTION 2

OPERATING INSTRUCTIONS

General

This section explains the use of the Type 3B3 as part of an oscilloscope system, the function of the Type 3B3's front panel controls, operating procedures peculiar to the Type 3B3, and how to display a signal.

Use

The Type 3B3 Plug-In Time Base Generator is normally used as part of an oscilloscope system composed of the Type 3B3, one of the Tektronix oscilloscopes listed in Section 1, and an appropriate vertical amplifier plug-in. When properly operated, the system can (a) determine if a certain event is happening, (b) make accurate measurements of the event, and (c) display the representation of the event in a manner that permits photographing. The functions of the Type 3B3 in such a system are threefold: it provides accurate time bases for precisely measuring the time dimensions of the event being analyzed; it provides a versatile trigger circuit to assure positive synchronization of the time bases with the event, and the single sweep feature provides exposure control when the display is to be photographed. In assembling an oscilloscope system, the Type 3B3 is inserted in the X-axis (right hand) opening of the oscilloscope. The vertical amplifier plug-in (a non-sampling vertical amplifier of the '3' series such as the Type 3A1) is inserted in the Y-axis (left-hand) opening.

Function of Front Panel Controls and Connectors

The front panel controls and connectors on the Type 3B3 are grouped into blocks according to the sweep circuit in which they function. The blocks of controls are outlined by a heavy black line printed on the front panel. Controls common to both sweep circuits are placed between the two blocks with the exception of the screwdriver adjustable SWEEP CAL. potentiometer which is located in the bottom right-hand corner of the front panel. Overcrowding of the front panel is avoided by giving some controls multiple functions and making others concentric. Table 2-1 lists the function of the individual controls and connectors.

TABLE 2-1

Function of Front-Panel Controls and Connectors

Control	Setting	Function
	Delayed Sweep Triggering Block	
LEVEL (PULL EXT. TRIG. ATTEN.)	Pushed in	When turned, sets the point on the slope of the input waveform at which the delayed sweep is triggered.
	Pulled out	Switches an internal 10X attenuator into the external trigger circuit, permitting use of external triggering signals in the 15- to 150-volt range. When turned, sets the point on the slope of the external triggering signal at which the delayed sweep is triggered.

TABLE 2-1 *(Cont'd)*

Control	Setting	Function
SLOPE	+	Sets the delayed-sweep triggering circuit to trigger on the rising (+) slope of the triggering signal.
	—	Sets the delayed-sweep triggering circuit to trigger on the falling (—) slope of the triggering signal.
COUPLING	AC	Inserts blocking capacitor in the delayed sweep trigger circuit to block any dc components of the triggering signal.
	DC	Shunts triggering signal around blocking capacitor and passes it directly to delayed sweep trigger circuit.
SOURCE	INT.	Switches input of delayed sweep trigger circuit to trigger source (vertical plug-in) within the oscilloscope system.
	EXT.	Switches input of delayed sweep trigger circuit to EXT. TRIG. connector on front panel.
EXT. TRIG. (Connector)		Provides means of connecting external trigger signal to the delayed sweep trigger circuit.
	Controls Common to Both Sweeps	
MODE	NORM.	Switches circuits in the Type 3B3 so that; the normal (delaying) sweep is displayed on the crt, the sweep rate is set by the normal sweep timing switch, and sweep triggering is selected by the NORMAL or DELAYING SWEEP TRIGGERING controls.
	INTEN.	Switches circuits so that the delayed sweep intensifies a portion of the normal sweep, the intensified zone starts at a point on the normal sweep determined by the setting of the DELAY TIME control, the width of the intensified zone is determined by the setting of the DELAYED SWEEP control, and the DELAYED SWEEP TRIGGERING controls are disconnected.
	TRIG. INTEN.	Same as INTEN. setting except that DELAYED SWEEP TRIGGERING controls are now connected and the start of the intensified zone depends upon

TABLE 2-1 *(Cont'd)*

Control	Setting	Function
		the settings of the DELAY TIME and DELAYED SWEEP TRIGGERING controls.
	DLY'D SWP.	Switches the Type 3B3 circuits so that, the crt display is the delayed sweep only; the delayed sweep starts at a point on the normal sweep determined by the setting of the DELAY TIME control, and the DELAYED SWEEP TRIGGERING Controls are disconnected.
	TRIG. DLY'D SWP.	Same as DLY'D SWP. setting except that the DELAYED SWEEP TRIGGERING controls are connected, and the start of the delayed sweep is determined by settings of the DELAY TIME and the DELAYED SWEEP TRIGGERING controls.
POSITION (PULL 5X MAG.)	Pushed in Pulled out	Positions trace on crt when turned. Switches in 5X magnification circuit. Positions trace on crt when turned.
TIME/DIV AND DELAY TIME RANGE (Scale)	Fixed	This is a scale printed on the front panel. The scale is common to both the normal sweep and the delayed sweep timing switches. When the MODE control is in TRIG. INTEN., NORM., or INTEN. positions, the scale indicates the time per division of the normal sweep. It also indicates 1/10th the time duration of the delayed sweep. In both DLY'D SWP. positions of the MODE control, the scale indicates time per division of the delayed sweep, and 1/10 of the normal sweep delay time range.
TIME/DIV AND DELAY TIME RANGE (Control)	Any	Selects and indicates the position of the normal sweep timing switch. This control is the clear plastic ring located between the DELAYED SWEEP control and the TIME/DIV. AND DELAY TIME RANGE scale. Position of the normal sweep timing switch is indicated by two black lines on the control. When the white dot on the DELAYED SWEEP control is positioned between the two black lines on the clear plastic ring, the two sweep timing switches lock together and are both turned by the DELAYED SWEEP controls. To unlock, pull the DELAYED SWEEP control out, turn one click in the desired direction, then release.
DELAYED SWEEP	Any	Selects and indicates the position of the delayed sweep timing switch. The white dot indicates sweep time duration divided by 10, or time per division. (See explanation of TIME/DIV AND DELAY TIME RANGE SCALE.) When the white dot is located between the two black lines on the clear plastic ring, this control also positions the normal sweep timing switch.
VARIABLE	UNCAL.	Provides variable (uncalibrated) sweep rates in between the fixed steps of the sweep timing switches and lights indicator light to warn that sweep is uncalibrated. When the MODE control is in NORM. position, the VARIABLE control varies the rate of the normal sweep. In all other positions of the MODE control, the variable control is in the delayed sweep.
	CAL.	Switches off the UNCAL. light.
SWEEP CAL.	variable (screwdriver adjustment)	Provides a means of compensating for differences in horizontal sensitivity when changing the Type 3B3 from one oscilloscope system to another.
Normal or Delaying Sweep Triggering Block		
DELAY TIME	variable	When the MODE control is in INTEN. or DLY'D SWP. positions the DELAY TIME control determines the point on the normal sweep at which the delayed sweep starts. When the MODE control is in either TRIG. position, the DELAY TIME control determines the point on the normal sweep at which the delayed sweep becomes triggerable. Delay time is read by multiplying the normal sweep DELAY TIME RANGE setting by the reading of the DELAY TIME dial. The ten major divisions on the DELAY TIME dial are units, the minor divisions are decimal.
Single Sweep	NORM.	Switches single sweep feature off.
	SINGLE SWEEP	Switches the single sweep feature on.
	RESET	Resets the single sweep circuit.

TABLE 2-1 *(Cont'd)*

Control	Setting	Function
		For single sweep operation of the Type 3B3, push the single sweep switch down to RESET, then release. If a trigger signal is present, a single sweep will appear on the crt. If there is no trigger signal present, the READY light will turn on and the single sweep will occur when a trigger signal is applied.
LEVEL (PULL EXT. TRIG. ATTEN.)	Pushed in	When turned, sets the point on the slope of the input waveform at which the normal sweep is triggered.
	Pulled out	Switches an internal 10X attenuator into the normal sweep external trigger circuit, permitting use of external triggering signals in the 15- to 150-volt range. When turned, sets the point on the slope of the external triggering signal at which the normal sweep is triggered.
SLOPE	+	Sets the normal sweep triggering circuit to trigger on the rising (+) slope of the triggering signal.
	—	Sets the normal sweep triggering circuit to trigger on the falling (—) slope of the triggering signal.
COUPLING	AUTO.	Switches the normal sweep to free-run operation. However, a suitable trigger will override the auto circuitry and trigger the sweep.
	AC	Inserts blocking capacitor in the normal sweep trigger circuit to block any dc components of the triggering signal.
	DC	Shunts triggering signal around blocking capacitor and passes it directly to normal sweep trigger circuit.
SOURCE	INT.	Switches input of normal sweep trigger circuit to trigger source (vertical plug-in) within the oscilloscope system.
	LINE	Applies 60 cycle triggering signal to normal sweep circuit.
	EXT.	Switches input of normal sweep trigger circuit to EXT. TRIG. connector on front panel.
EXT. TRIG. (Connector)		Provides means of connecting external trigger signal to the normal sweep trigger circuit.

First Time Operation

The steps that follow are designed to instruct the operator in the use of the Type 3B3. The steps cover the controls to use, how and when to use it, and the expected results.

Normal Sweep Triggering Controls

1. Preset the Type 3B3 controls as follows:

   MODE — NORM.

   POSITION — Center of range and pushed in DELAYED SWEEP. Line up the white dot between the two black lines on the clear plastic ring, then set the two black lines to straddle the 5 mSEC position on the TIME/DIV AND DELAY TIME RANGE scale.

   VARIABLE — CALIB.

   NORMAL OR DELAYING SWEEP TRIGGERING:

LEVEL	Center of range and pushed in.
COUPLING	AUTO.
SOURCE	INT.
Single Sweep	NORM.

2. Turn the instrument on and connect a cable from the oscilloscope calibrator to the input connector on the vertical amplifier plug-in.

3. Set the calibrator output for 1 volt and adjust the VOLTS/DIV. switch on the vertical amplifier plug-in for several divisions of vertical deflection. There should now be several cycles of a steady (triggered) calibrator waveform on the crt.

4. Turn the LEVEL control fully clockwise. The display should float (free-run) across the crt. Now return the control slowly toward the center until the display seems to lock into a steady position. Turn the control fully counterclockwise; again the display should float. Turn toward the center until the display locks into a steady position. Try this several times from both extremes of the control. When the display locks into a steady position, the sweep is triggered.

5. Set the COUPLING switch to DC. Turn the LEVEL control to center. The display should be steady. Now turn the control away from center; notice that instead of free-running, the trace disappears.

6. Set the COUPLING switch to AC; the controls should have the same effect as in step 5.

7. Notice that the display starts at either the top or the bottom of a pulse. Set the SLOPE switch to the opposite polarity; the trace should reverse and start opposite to its first condition.

8. Connect a cable from the calibrator to the NORMAL or DELAYING SWEEP TRIGGERING, EXT. TRIG. connector. Set the SOURCE switch to EXT.

9. Repeat steps 4 through 7. Notice that the trigger controls work the same as for internal trigger signals except that the LEVEL adjustment may be more critical. External trigger signals should be used in certain applications, and these are explained later in the text.

Delayed Sweep Controls

1. Set the NORMAL OR DELAYING SWEEP TRIGGERING-SOURCE switch to INT., COUPLING to AUTO., and adjust the controls for a steady display.
2. Set the DELAY TIME control to 5.00 and turn the MODE control to INTEN. (to the right of NORM.)
3. Pull the DELAYED SWEEP control out and turn it one click to the right. Adjust the INTENSITY control on the oscilloscope and notice that a portion of the display is intensified. Turn the DELAY TIME control and the intensified portion moves across the crt.
4. Turn the DELAYED SWEEP control further to the right. Each click makes the intensified display smaller although it can still be moved by the DELAY TIME control.
5. Turn the MODE control to DLY'D SWP (on the right). The intensified zone seen in the previous step should expand and cover the full width of the crt. The width of the intensified zone set in step 4 is always expanded to the full width of the crt when the MODE control is turned to DLY'D SWP.

The following steps cover the DELAYED SWEEP TRIGGERING controls at the top of the Type 3B3.

1. Return the MODE control to NORM. and the TIME/-DIV and DELAY TIME RANGE controls to 5 mSEC.
2. Set the DELAYED SWEEP TRIGGERING controls as follows:

LEVEL	fully counterclockwise
SLOPE	+
COUPLING	AC
SOURCE	INT.

3. Turn the MODE control to TRIG. INTEN. and adjust the INTENSITY control so that the display is barely visible. Turn the Delayed Sweep LEVEL control through its range; notice a portion of the trace intensifies as the control passes midrange. Leave the control at midrange.
4. Pull out the DELAYED SWEEP control and turn it several clicks to the right. The intensified portion of the display will get smaller.
5. Turn the MODE control to TRIG. DLY'D SWP; the intensified portion of the display expands across the full width of the crt.
6. Set the delayed sweep SLOPE control to the opposite polarity; the display should invert and remain stable.
7. Set the delayed sweep COUPLING switch to DC; the display may disappear. Readjust the delayed sweep LEVEL control and the display should return.
8. Connect a cable from the calibrator to the Delayed sweep EXT. TRIG. jack. Set the SOURCE control to EXT. Adjust the delayed sweep LEVEL control, if necessary, until the trace appears.

The following description covers single sweep operation. Single sweep can be used with either normal or delayed sweep.

First set the controls for a normal triggered display (use INT. coupling). Then push the single sweep control to RESET and a single sweep will occur.

To trigger a single sweep proceed as follows:

1. Set the single sweep control to SINGLE SWEEP.
2. Remove the trigger signal. This can be done in several ways, such as:
   a. Turn the Normal Sweep LEVEL control either clockwise or counterclockwise.
   b. Set the normal trigger SOURCE control to EXT.
   c. Remove the input signal.
3. Push the single sweep control to RESET and release. The READY light should turn on.
4. Apply a trigger signal and the crt will show a single sweep.

Trigger Selection

The choice of triggering to use depends on the type and portion of the signal to be displayed. For example, if the display starts on the leading edge of the signal and it is desired to start on the trailing edge, set the SLOPE control to the other position.

The AUTO position of the COUPLING is useful from approximately 15 cps to 10 mc. It has the advantage of showing a trace when the signal is removed, or when the amplifier input is grounded. This makes it easy to check a reference graticule line, since the trigger controls need not be touched.

The AC position of the COUPLING control is the same as for AUTO except for the free-run of the display. Both the AUTO and AC positions reject any dc component in triggering the signal. Adjusting the POSITION control on the vertical amplifier plug-in does not affect triggering in the AUTO or AC coupling positions.

In the DC position of the COUPLING control, the sweep will trigger in the range from dc to 10 mc. This position should be used with signals that change slowly, such as a slow-rising sawtooth. The normal sweep LEVEL control is used to trigger the sweep at any voltage point on these slow-rising signals. With the LEVEL control centered the sweep will start as the signal voltage crosses the zero voltage point.

For most applications the trigger SOURCE control should be used in the INT. position. However, if the frequency of the signal is related to the line frequency (60 cps), use the LINE position of this control.

External triggering should be used when signals are to be sampled from several points within a device, such as in point to point troubleshooting. With external triggering, the trigger controls do not have to be adjusted for each point check.

Delayed Triggering

This type of triggering has the advantage of practically eliminating jitter in the display during delayed-sweep operation. Each sweep is triggered by the expanded portion of the waveform and not by the waveform at the beginning of the normal sweep. For example, assume a pulse train

output from a computer circuit. You want to examine a small pulse 5 microseconds from the start of the pulse train. Use the TIME/DIV. and the DELAYED SWEEP controls and the TRIG. DLY'D SWP position of the MODE control to expand the display to show only the small pulse. Then adjust the Delayed Sweep LEVEL control for a stable display. The sweep will then be triggered by the expanded portion and not by the start of the pulse train.

The SLOPE, COUPLING, and SOURCE controls work the same as their counterparts in normal-sweep operation. The choice of position for these controls depends on the type of waveform being examined.

Sweep Magnification

The display can be expanded to 5 times its normal width by pulling out the 5X MAG. control (POSITION control). Each part of the expanded display can be examined by turning the POSITION control through its range.

The sweep magnifier extends the range of the TIME/DIV. switch 5 times. For example, with the TIME/DIV. switch set at .5 μSEC and the 5 X MAG. switch pulled out, the actual time per division is 0.1 microsecond (VARIABLE control in the CALIB. position). The magnifier works the same for either normal or delayed sweep.

Sweep Cal. Check

This check should be made whenever the Type 3B3 is used with a different oscilloscope since the deflection plate sensitivity may not be the same. The accuracy of this check depends on the frequency of the power line supplying the instrument being exactly 60 cps, since this frequency is used to synchronize the calibrator.

Make the check as follows:

1. Set the MODE control to NORM.
2. Set the TIME/DIV. switch to 5 mSEC (be sure the 5 X MAG. switch is pushed in).
3. Connect a cable from the oscilloscope calibrator to the vertical amplifier plug-in and adjust the normal sweep triggering controls for a stable display.
4. There should be exactly 3 cycles of the calibrator signal across the 10 divisions of the graticule. If there is not, adjust the SWEEP CAL. control until there is.

NOTES

SECTION 3

APPLICATIONS

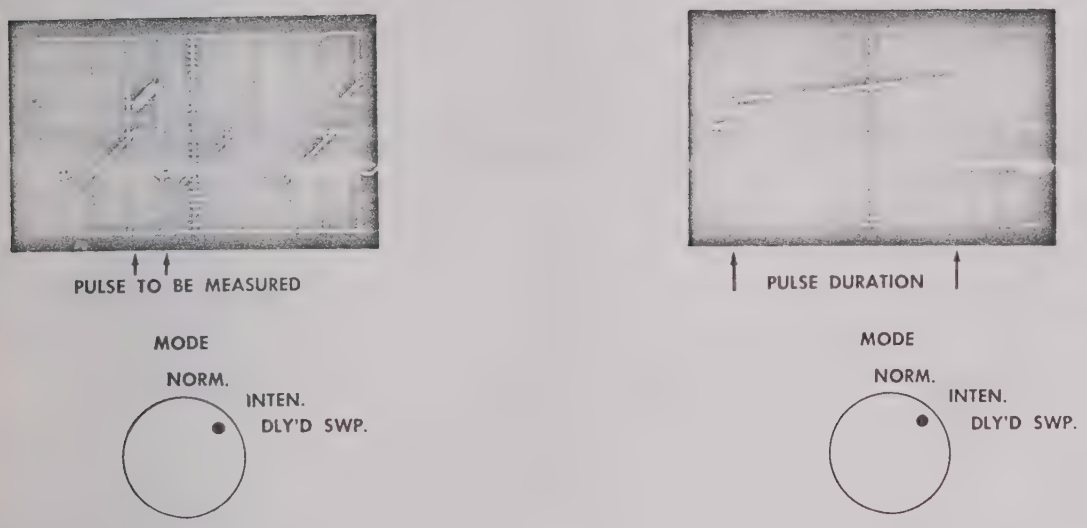


Fig. 3-1. Pulse Duration Measurement

General

This section describes typical applications for the Type 3B3 Time Base unit. Since the number of applications for the Type 3B3 is large, this section covers only a few. Included are measurements of time, frequency, phase-shift, and waveform jitter.

Time Measurements

The calibrated sweeps of the Type 3B3 cause any horizontal distance on the crt to represent a definite time interval. Thus, the time interval between points on a display can be accurately measured (within 3%).

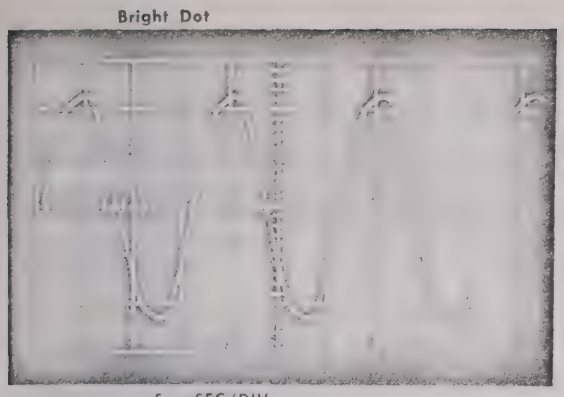
For example, assume you have a normal-sweep crt display similar to Fig. 3-1 and you wish to measure the duration of one pulse.

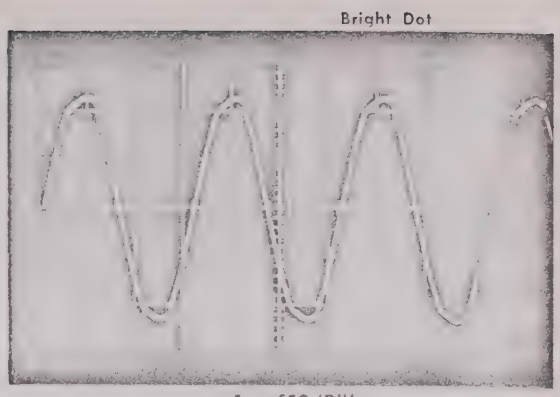
1. Make sure the VARIABLE control is set to CALIB., then pull out the DELAYED SWEEP control and turn it two clicks to the right.
2. Turn the MODE control to INTEN. (clockwise), and adjust the oscilloscope INTENSITY control to show an intensified zone on the display.
3. Turn the DELAY TIME control until the intensified zone begins at the start of the desired circle.
4. Turn the MODE control to DLY'D SWP. (clockwise) and measure the horizontal distance from the 50% point on the rise of the pulse to the 50% point on the fall of the pulse. Multiply this distance by the setting of the DELAYED SWEEP control (setting of white dot on large black knob).

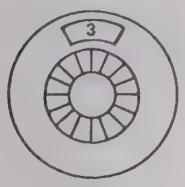
Measurements with DELAY TIME Control

The following technique minimizes human errors (parallax, interpolation of graticule lines) that occur with graticule measurements and should be used when more than routine accuracy is needed. (See Fig. 3-2.)

1. Set the MODE control to INTEN. (clockwise) and adjust the controls to display one cycle of the signal.
2. Adjust the oscilloscope intensity to make the intensified part of the trace stand out. Pull out the DELAYED SWEEP control and turn it to the right until the intensified area is a small bright dot.
3. To measure pulse duration, turn the DELAY TIME control until the bright dot is at the 50% point on the leading edge of the pulse. Record the reading of the dial. For best accuracy, this reading should be greater than 1.00.
4. Turn the DELAY TIME control to move the bright dot to the 50% point on the trailing edge of the same pulse as step 3. Record the reading of the dial.
5. Subtract the reading of step 3 from that of step 4, then multiply the remainder by the setting of the TIME/DIV. switch. The product is the pulse width.

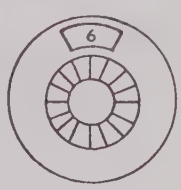






First Reading = 3.15

6.48 — 3.15 = 3.33
Time for one cycle = 3.33 x 5 mSEC = 16.666 mSEC.

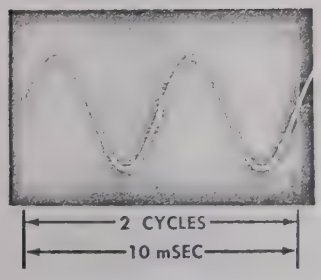


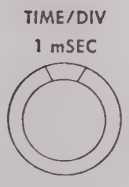
Second Reading = 6.48

Fig. 3-2. Time measurements with DELAY TIME control

Frequency Measurements

Time measurements may also be used for frequency measurements. Since frequency and time are reciprocal functions, the frequency of any signal is the reciprocal of the period (time) for one cycle. For example, if the time for one cycle is 0.2 microsecond, the frequency is 5 megacycles.





$$\frac{\text{NUMBER OF CYCLES IN 10 DIVISIONS}}{\text{10 X TIME/DIV SWITCH SETTING (EXPRESSED IN SECONDS)}} = \text{FREQUENCY}$$

$$\frac{2}{10 \times 1\ \text{mSEC}} = \frac{2}{.01\ \text{SEC.}} = 200\ \text{CYCLES PER SECOND}$$

Fig. 3-3. Frequency Measurement

With any sweep rate, the number of cycles displayed across 10 divisions of the graticule depends on the frequency of the waveform (see Fig. 3-3). To determine the frequency, proceed as follows:

1. Set the TIME/DIV. switch to display several cycles of the waveform (be sure the VARIABLE TIME/DIV. control is in the CALIB. position).
2. Count the number of cycles across the 10 divisions of the graticule.
3. Divide this number by 10 times the TIME/DIV. switch setting. This is the frequency of the waveform.

For example, assume that you are using a sweep rate of 5 mSEC/DIV. and you count 3 cycles across the 10 divisions. Multiply 5 milliseconds by 10 (number of divisions); this equals 50 milliseconds or 0.05 second. Dividing 3 cycles by 0.05 second, the frequency is 60 cycles per second.

Phase-Shift Measurement

To measure the phase difference between two sine waves, proceed as follows:

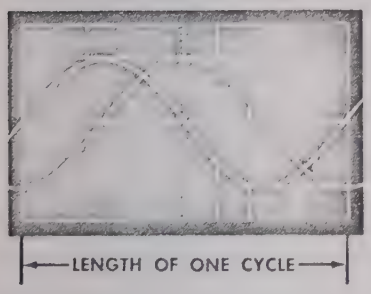
1. Set up the Type 3B3 for normal-sweep operation and connect a triggering signal (related to the two to be measured) to the NORMAL SWEEP TRIGGERING EXT. TRIG. jack. Then connect one of the signals to be measured to the input connector of the vertical amplifier unit.
2. Set the TIME/DIV. switch so that at least one cycle of the sine wave is displayed on the crt.
3. Vertically center the display and horizontally position it so that one of the positive slopes crosses the centerline at the left side of the graticule (see Fig. 3-4).

4. Measure the time duration of one cycle of the waveform.

5. Without making any adjustments, disconnect the first sine wave from the vertical amplifier and substitute the second. (Normally this can be done simply by moving the probe from one signal source to the other.) Vertically center the display. If there is a phase difference between the two sine waves, you will find that the display has shifted horizontally.

6. Measure the amount of horizontal shift in the display. (You may increase or decrease the deflection sensitivity of the vertical amplifier to make the measurement easier, but be sure the display remains centered.)

7. Divide the distance measured in step 6 by the distance measured in step 4 and multiply the result by 360°. This is the phase difference (within 3%) between the two sine waves.



$$\frac{\text{SHIFT (FROM STEP 6)}}{\text{LENGTH OF ONE CYCLE (STEP 4)}} \times 360° = \text{PHASE DIFFERENCE}$$

$$\frac{2.5 \text{ (div.)}}{10 \text{ (div.)}} \times 360 = 90°$$

Fig. 3-4. Phase Measurement

Pulse Jitter Measurements

Pulse jitter is defined as relatively small variations in pulse spacing in a pulse train. For example, assume a normal sweep pulse train is displayed on the crt, and you wish to check a small pulse in the train for jitter. The following steps may be used.

1. Turn the MODE control to INTEN. (clockwise). Pull out the DELAYED SWEEP control and turn it to the right until the intensified zone of the display is about the same width as the pulse to be checked.

2. Turn the DELAY TIME control to move the intensified zone over the pulse.

3. Turn the MODE control to DLY'D SWP (clockwise) and adjust the DELAY TIME control to place the intensified pulse at the center of the crt.

4. The intensified pulse will then show jitter if present. The amount of jitter can be measured (in time) by multiplying the horizontal distance in divisions (of the jitter area; see Fig. 3-5) by the setting of the DELAYED SWEEP knob (setting of white dot on large black knob).

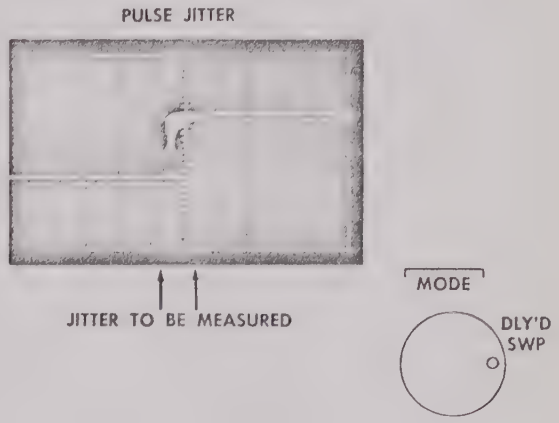


Fig. 3-5. Measurement of Pulse Jitter

Non-repetitive Pulse Displays

In a device where a trigger pulse initiates a second pulse which occurs at a later time, delayed sweep should be used.

For example, assume a trigger pulse occurs in a system, and five seconds later a second pulse occurs. Also assume that the duration of the second pulse is 5 milliseconds. With a sweep of 10 seconds, the second pulse would probably just be invisible. With delayed sweep the pulse can be examined in detail. The technique is as follows.

1. Set the TIME/DIV. switch of the normal sweep to 1 SEC.

2. Set the DELAYED SWEEP control to 10 mSEC.

3. Set the DELAY TIME control to 5.00.

4. Turn the MODE control to NORM. and adjust the controls for a triggered sweep.

5. Turn the MODE control to DLY'D SWP (clockwise). The second pulse will be displayed 5 seconds after the initial trigger pulse. The pulse can then be photographed.

NOTES

SECTION 4

CIRCUIT DESCRIPTION

General

The Type 3B3 is a conventional time-base unit with delayed sweep. The simplified block diagram of Fig. 4-1 shows the relationship of the major circuits. The schematic diagrams at the rear of the manual should be referred to when studying this circuit description.

The Normal Sweep Trigger circuit receives a signal from either the Vertical Amplifier plug-in or from an external source. The circuit converts the signal to a trigger pulse for the Normal Sweep Generator. This trigger pulse switches a tunnel diode in the Normal Sweep Generator and starts the sweep ramp. When the ramp voltage reaches a preset point (normal sweep length), the ramp ends and the crt beam (now blanked) returns to its starting point. A holdoff period delays the start of the next sweep. When this period ends, the next trigger pulse starts another sweep.

The start of the delayed sweep is controlled by the normal sweep rate and the setting of the DELAY TIME control. The delayed sweep rate is set by the DELAYED SWEEP control.

The sweep ramp from both sweep generators passes to the MODE switch. If this switch is set to NORM., INTEN., or TRIG. INTEN., the normal sweep passes to the Horizontal Amplifier. In the DLY'D SWP or TRIG. DLY'D SWP positions of the MODE switch, the delayed sweep passes to the Horizontal Amplifier.

The Horizontal Amplifier converts the sweep ramp to a push-pull output and applies it to the horizontal deflection plates of the crt.

The Delayed Sweep Trigger circuit operates only when the MODE switch is in the TRIG. INTEN. or TRIG. DLY'D SWP position. This circuit is identical to the Normal Sweep Trigger circuit and uses a signal from either the Vertical Amplifier or an external source.

The trigger pulse formed by the Delayed Sweep Trigger circuit passes to the Delayed Sweep Generator and starts the delayed sweep ramp. The ramp ends when it reaches a preset point (delayed sweep length). During the ramp run-up a positive pulse is coupled to the crt grid to intensify the display.

The two INTEN. positions of the MODE switch show an intensified area of the display that represents both the delayed sweep duration and its position with respect to the start of the normal sweep.

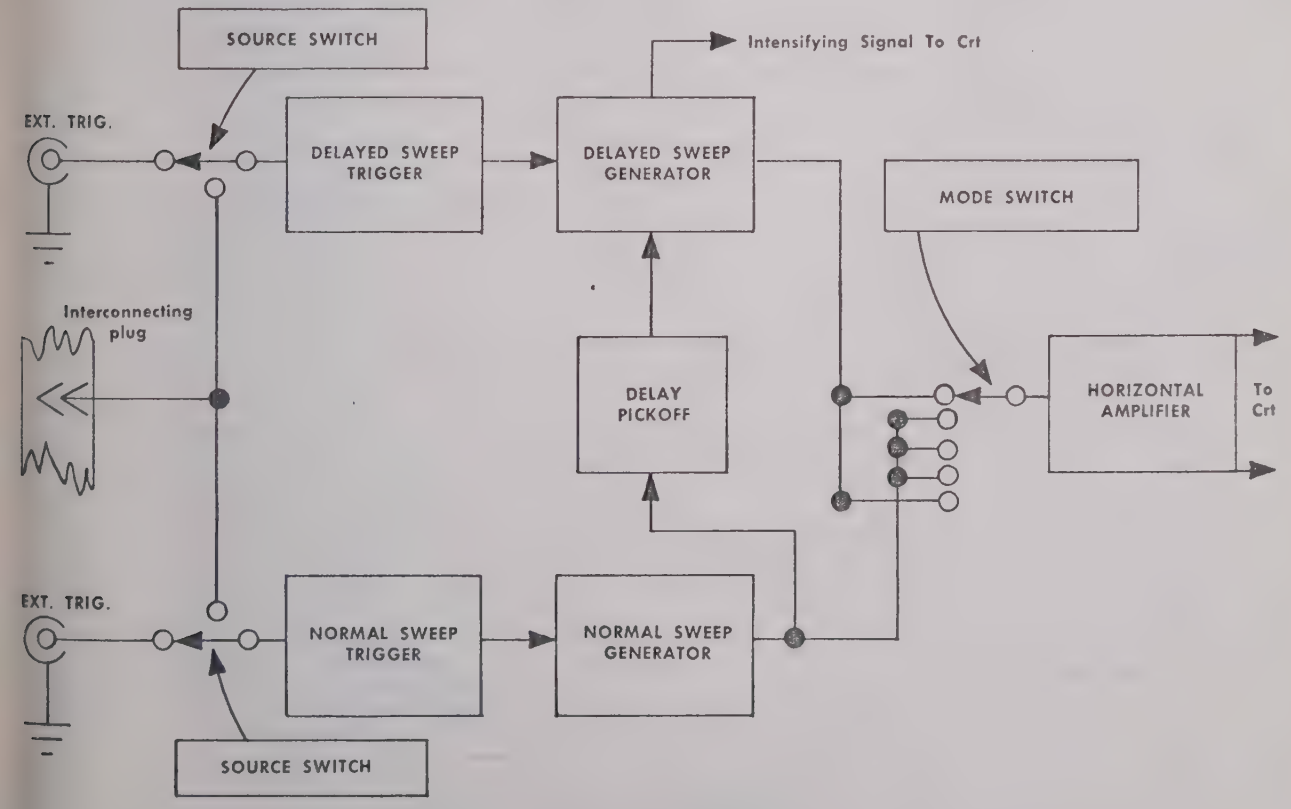


Fig. 4-1. Simplified Block Diagram of Type 3B3.

Normal Sweep Trigger

The trigger signal (internal or external) enters the circuit through the SOURCE switch and passes to the COUPLING switch. The COUPLING switch passes the signal through a capacitor in the AUTO or AC positions; in the DC position the capacitors are bypassed. R9 and R10 attenuate the signal about 25% and present a high impedance load to the signal source.

When the SOURCE switch is in the EXT. position and the PULL EXT. TRIG. ATTEN. switch is pulled out, R7 is paralleled across R10 and the network becomes an approximate 10 to 1 attenuator. C7 and C9 are frequency compensating capacitors. Neon bulb B10 provides overload protection against high signal voltages. V13 is a long-tailed cathode follower that couples the signal through diode D15 to the SLOPE switch. Diodes D15 and D16 protect transistors Q24 and Q34 from excessive positive voltages. The SLOPE switch directs the signal to either Q24 or Q34 depending on its setting. Q24 and Q34 are a comparator with the signal applied to one base and a dc voltage set by the LEVEL control on the other base. Diodes D24 and D34 prevent emitter to base breakdown of Q24 and Q34. When the signal equals the level voltage, tunnel diode D35 switches. The pulse from D35 is amplified by Q44 and applied to T101. This transformer couples the pulse to the Normal sweep generator.

Normal Sweep Generator

With the COUPLING switch in AC or DC position, sweep ramp generation starts when a trigger pulse coupled through T101 causes tunnel diode D105 to switch to its high state. This puts a positive pulse on the base of Q114. Q114 turns on hard and its collector voltage goes negative. This negative change drops the voltage on the plates of V152 and the tube cuts off. When V152 cuts off, the timing capacitor C160 starts to change toward —100 volts through the timing resistor R160. As the grid of V161A starts to drop, its plate voltage starts to rise. The resulting positive swing is coupled through D162 and V161B to the top of C160. This increases the potential to which C160 is trying to charge. The effect is to straighten out the charging curve by increasing the charging voltage with each increment of charge on the capacitor. The positive swing at the top of the timing capacitor also tends to keep the lower side from drooping. This keeps the voltage across R160 essentially constant, providing a constant-current charging source for the timing capacitor. The result is an extremely linear sawtooth ramp at the cathode of V161B, which is then applied to the horizontal amplifier.

The sweep ramp ends when the voltage applied to the base of Q145 reaches approximately +4 volts. Fig. 4-2 shows the waveform on the base of Q145 with the condition of associated diodes. Fig. 4-3 shows the condition of D105 (tunnel diode) during a sweep cycle.

The sweep ramp voltage at the arm of the NORMAL SWEEP LENGTH control (R168) starts at about —38 volts. D171 is back-biased and the ramp voltage cannot reach the base of Q145. As the voltage reaches —2 volts, D171 is forward-biased and the ramp voltage is applied to the base of Q145.

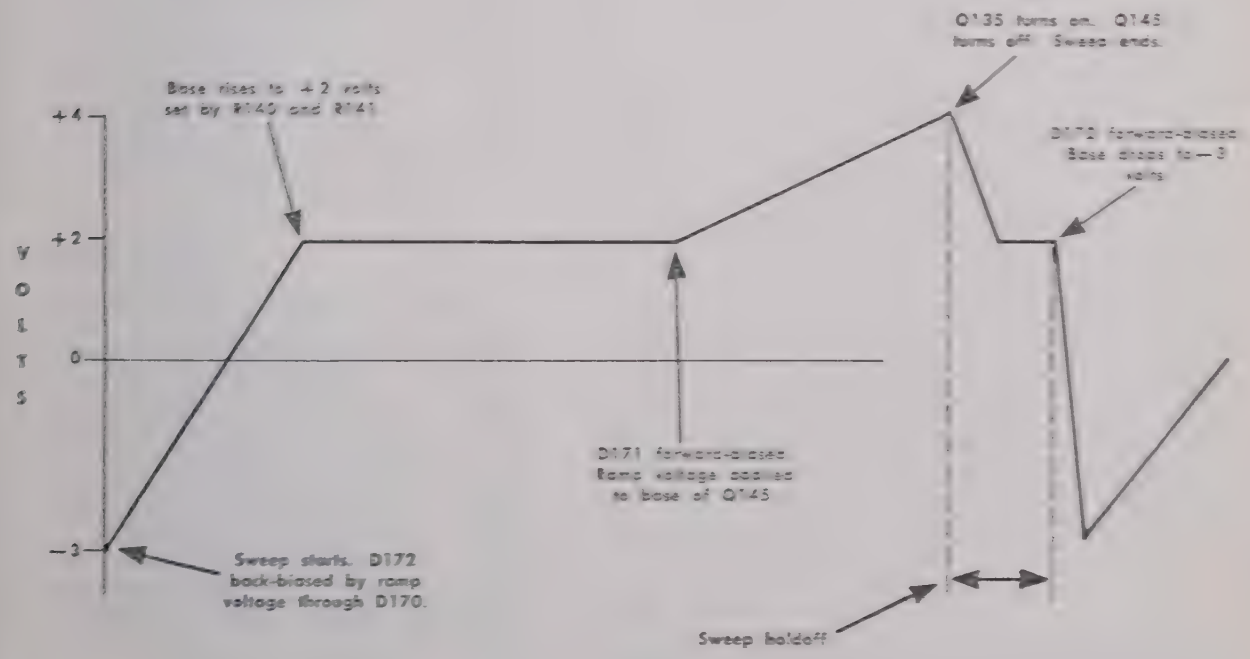

Q135 turns on. Q145 turns off. Sweep ends.
Base rises to +2 volts set by R140 and R141
D172 forward-biased. Base drops to —3 volts
+4
+2
0
—3
VOLTS
D171 forward-biased. Ramp voltage applied to base of Q145
Sweep starts. D172 back-biased by ramp voltage through D170.
Sweep holdoff

Fig. 4-2. Waveform at base of Q145 with condition of associated diodes.

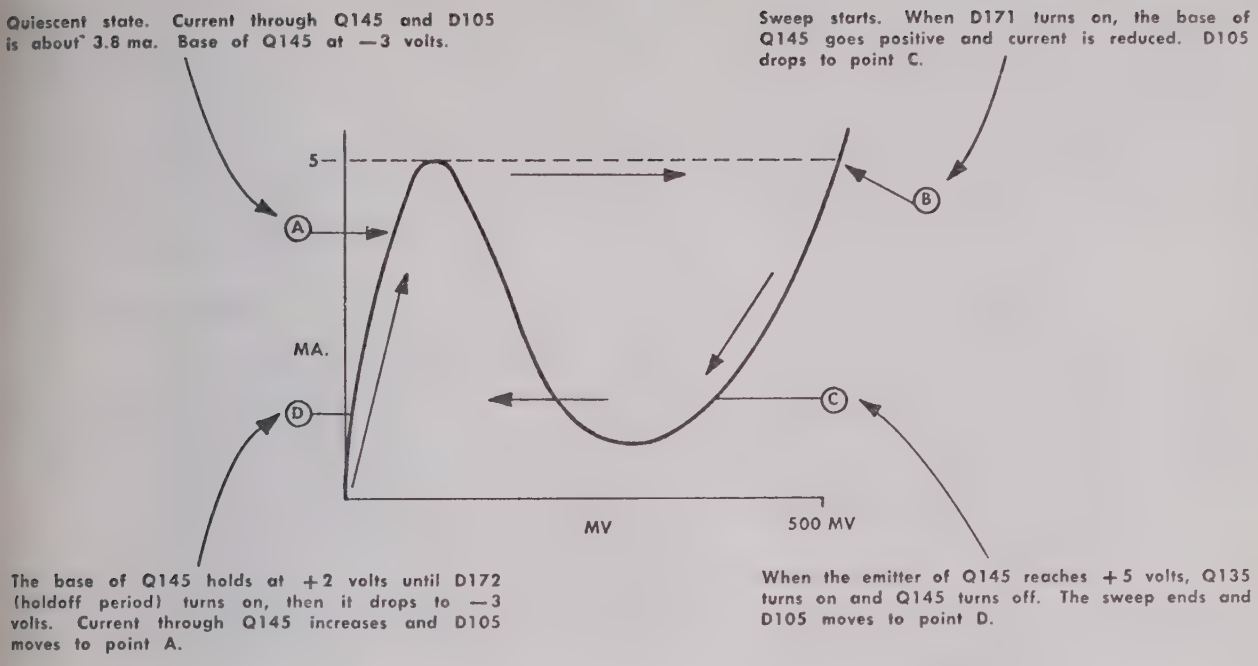

Quiescent state. Current through Q145 and D105 is about 3.8 ma. Base of Q145 at —3 volts.
Sweep starts. When D171 turns on, the base of Q145 goes positive and current is reduced. D105 drops to point C.
5
A
B
MA.
D
C
MV
500 MV
The base of Q145 holds at +2 volts until D172 (holdoff period) turns on, then it drops to —3 volts. Current through Q145 increases and D105 moves to point A.
When the emitter of Q145 reaches +5 volts, Q135 turns on and Q145 turns off. The sweep ends and D105 moves to point D.

Fig. 4-3. Condition of Tunnel Diode D105 during sweep and holdoff periods

The voltage at the emitter of Q145 follows the base voltage in a positive direction. When the emitter rises to +5 volts, Q135 turns on. This quickly drops the emitter of Q145 to —0.5 volt and it turns off. When Q145 turns off, the current source for D105 is removed and the tunnel diode switches to its low state. This negative change turns Q114 off and allows the plates of V152 to go positive. V152B conducts and timing capacitor C160 discharges through V152B and the cathode resistors of V161B, ending the sweep ramp.

Sweep Holdoff Period

A holdoff period is necessary between each sweep to prevent display jitter. This is done by preventing the sweep from being retriggered until the whole system is again stable and the electron beam is at the left side of the crt. The holdoff period is developed by the charge and discharge of holdoff capacitor C170. The circuit works as follows: During sweep run-up, the sweep voltage charges C170 through D170. When the sweep ends, C170 discharges exponentially. When the capacitor charge drops to about —3 volts, D172 becomes forward biased and this voltage is applied to the base of Q145. Current through Q145 increases, which causes tunnel diode D105 to move to its ready state (point A on Fig. 4-3). A trigger can now start another sweep.

Automatic Sweep

If the COUPLING switch is set to AUTO., transistor Q124 provides an additional source of current for Q145. This added current switches D105 (at the end of the holdoff period) and the sweep free-runs. (See Fig. 4-4).

To trigger in the AUTO. position, a positive trigger pulse from T101 is applied through D119 to a monostable multivibrator consisting of transistors Q115 and Q125. The trigger pulse (applied to the base of Q125) turns on Q125 and the collector voltage of Q125 drops to —5 volts. This negative change back biases D125 and removes Q124 as a current source for Q145. The circuit is now set for normal triggered operation. If a trigger pulse does not switch D105 within about 60 milliseconds, the monostable circuit will reset itself, turn Q124 back on, and free-run the sweep.

The trigger pulse that turned on Q125 is of short duration. Transistor Q125 would normally stay on for the period of the pulse width. However, C115 (in the collector circuit of Q125), prevents the rapid change of voltage. Instead, the RC voltage rise takes about 60 milliseconds. At that time D125 becomes forward biased and the sweep free runs. Because of this reset feature of the AUTO. circuit, the sweep will not trigger at a repetition rate slower than about 15 cps. The use of Q115 and Q125 in a monostable multivibrator assures rapid turn-on of Q125.

Single Sweep

Transistors Q135 and Q145 form a bistable multivibrator. When the Single Sweep control is pushed to RESET, —100 volts is applied through a differentiating network to the base of transistor Q145. Transistor Q145 is biased into conduction, cutting off transistors Q134 and Q135 and biasing tunnel diode D105 at the ready point. The cutting off of

Q134 removes the shunt path from around the READY lamp B134, and B134 lights. With the arrival of a trigger pulse, tunnel diode D105 is biased to its high state and triggers the Miller runup circuit. As the Miller circuit runs up, the rising positive voltage is coupled back through diode D171 to the base of Q145, eventually cutting off Q145. When Q145 cuts off, diode D105 drops to its low state and the sweep ends. Also when Q145 cuts off, Q134 and Q135 are permitted to conduct. Transistor Q134 extinguishes the READY lamp, and Q135 keeps Q145 cut off until the Single Sweep control is pushed to RESET.

Timing Switch

Timing in the Miller run-up circuit is determined by Timing Capacitor C160 charging through Timing Resistor R160. Timing Switch SW160 selects the proper combination of timing resistor and timing capacitor for each sweep rate. In the NORM. position of the MODE switch, uncalibrated variable sweep rates are available. If uncalibrated sweep rates are desired, the VARIABLE control (red knob) is turned away from the CALIBRATED position. This control, R160Y, varies the sweep rate over a $2\frac{1}{2}$ to one range. Switch SW160Y is ganged with the VARIABLE control in such a way that the UNCALIBRATED light comes on when the control is turned away from the CALIBRATED position.

CRT Unblanking

The electron beam in the crt is unblanked by a negative waveform coupled from the plate of V194A through pin 13 of the interconnecting plug to the blanking plates in the crt. The unblanked period coincides with the time that tunnel diode D105 is in its high state (sweep period). When D105 switches to its high state, Q114 turns on and a negative pulse from its collector is applied to the base of Q182. This transistor is connected as an emitter follower and the negative pulse passes to the MODE switch. From the MODE switch it passes to the base of Q194, where it is amplified and coupled to the grid of V194A. A clamp circuit (D195 and R195) prevents the plate of V194A from dropping below +125 volts.

Delayed Sweep Trigger

This circuit is almost identical to the normal sweep trigger circuit and the detailed description is the same. The only difference is the supply voltage for the comparator (Q74 and Q84). The +125-volt supply is connected through the MODE switch and is only present in the TRIG. positions of this switch. In all other positions of the MODE switch the delayed sweep trigger circuit is inoperative.

Delayed Sweep Generator

The part of this circuit that forms the delayed sweep ramp is the same type as that in the normal sweep generator . The major difference between the two sweep generators is the method of starting the sweep.

Transistors Q235 and Q245 and associated circuit elements form a bistable flip-flop. With the MODE switch in the

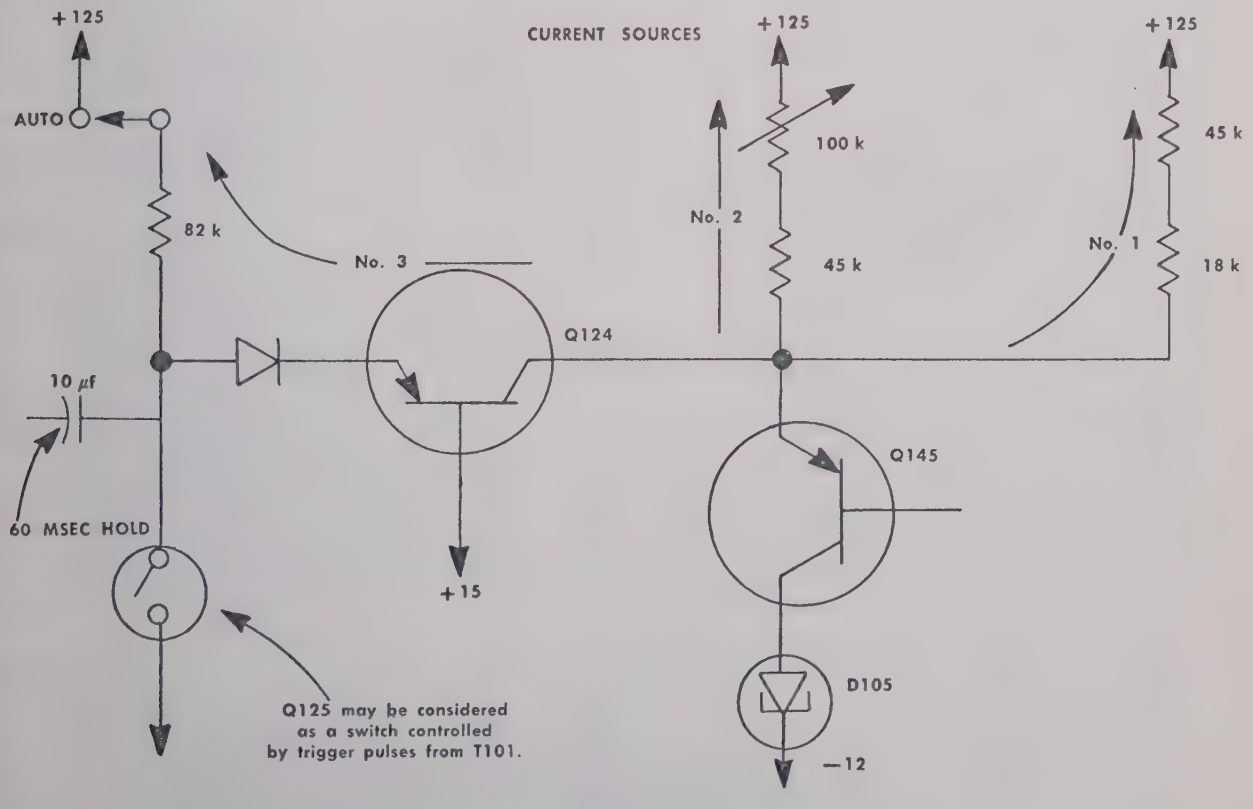


Fig. 4-4. Simplified drawing showing current sources for Q145 in AUTO mode.

NORM. position, the flip-flop is made inoperative by opening the emitter circuit. In all other positions of the MODE switch, the flip-flop gates the delayed sweep circuit.

With the MODE switch in INTEN. or DLY'D SWP. positions, current for the emitter circuit of the transistors and for tunnel diode D205 flows through three parallel resistance paths. For purposes of explanation, assume that Q235 is conducting and Q245 is cut off. The arrival of a delayed trigger pulse from C424 at the base of Q245 switches the flip-flop and Q245 conducts. Due to the three parallel resistance paths in the emitter circuit of Q245, the current through Q245 and D205 switches D205 to its high state, triggering the sweep circuit. As the sweep runs up, Diode D270 becomes forward biased and applies an increasing positive voltage to the base of Q245. The positive voltage applied to the base of Q245 eventually cuts off Q245, ends the sweep and resets the flip-flop.

When the MODE switch is in the TRIG. INTEN. or TRIG. DLY'D SWP. position, R229 is switched out of the parallel resistance network. The arrival of a delayed trigger pulse from C424 at the base of Q245 causes the flip-flop to switch, but due to the increased resistance in the emitter circuit, the current through Q245 is insufficient to cause D205 to switch to its high state. Instead, D205 is moved to the ready point, and switches to its high state only if it receives a trigger pulse from the delayed sweep trigger circuit. With the arrival of a trigger pulse, D205 switches to its high state and triggers the delayed sweep. The run-up of the sweep applies a positive voltage to the base of Q245, ends the sweep and resets the flip-flop as before.

Intensifying Circuit

Th negative pulse (during sweep) at the collector of Q214 passes directly to the base of Q283. This emitter follower sends the waveform in two directions: (1) to Q294 to intensify the display, and (2) to the MODE switch for unblanking the crt when operating in either of the DLY'D SWP. position of the MODE switch.

Delay Pickoff

This circuit sets the start point for the delayed sweep. V414 is a comparator with the normal sweep ramp voltage applied to one grid, and a positive dc voltage from the DELAY TIME control applied to the other grid. At the start of a normal sweep, V414B is conducting and V414A is cutoff. V194B is a constant-current source for the comparator. When the normal sweep voltage to the gird of V414A rises to equal the delay time voltage, the comparator switches and V414A turns on while V414B cuts off. At this point tunnel diode D415 switches to its low state and puts a more positive voltage on the base of Q424. This signal is inverted in polarity and coupled as a differentiated negative pulse through C424 to the Delayed Sweep Generator circuit at the base of Q245.

Horizontal Amplifier

The sweep voltage enters the circuit through the MODE switch. When this switch is in NORM. or either INTEN. position, the normal sweep ramp voltage drives the Horizontal Amplifier. In the two DLY'D SWP positions, the de'ayed sweep ramp voltage drives the amplifier.

The sweep voltage (0.04 Volt/cm at emitter of Q314) drives the emitter of Q314 through R310 and R312 (SWP. CAL.). The POSITION control is also current connected to the emitter of Q314. Since the Horizontal Amplifier is dc coupled, a small current change by the POSITION control biases the signal enough to position the sweep on the crt.

Q314 is a grounded-base amplifier and amplifies the sweep signal without changing the polarity. The sweep voltage then drives the base of emitter follower Q323 and passes from its emitter to the base of Q354. Transistor Q333 balances any changes in Q323 due to temperature drift.

The output stage of the horizontal amplifier is a hybrid paraphase circuit that matches the low-voltage, low impedance characteristics of the transistorized circuitry to the high-voltage, high impedance characteristics needed to drive the crt deflection plates. The ramp voltage from transistor Q323 drives transistor Q354. Transistor Q354 in turn drives grounded grid amplifier V383A, and by sharing emitter current with grounded base transistor Q364, drives that transistor and grounded grid amplifier V383B in push-pull.

The gain of the paraphase amplifier is determined by the amount of degeneration in the emitter circuit. In normal operation, resistor R364 in the emitter circuit of Q354 and Q364 acts as a voltage divider which reduces coupling between the two transistors. At the same time, it is in the emitter circuit of the transistor which is conducting and reduces the amount of current drawn. When the 5X MAG. switch is closed, R364 is shunted by a low resistance, the coupling between the two transistors is increased, and the resistance of the current path from the emitters to the —100 volt supply is decreased. The result of shunting R364 with a low resistance is to increase the gain of the paraphase amplifier; in this case the gain is increased five times (Calibrated by the 5X gain adjustment).

Capaitors C364, C354, and C356 across emitter coupling resistors R354, R355, R356 and R364 compensate for distributed capacitance at the output tube plates that may affect linearity at fast sweep rates. The push-pull output from the plates of V383A and V383B is coupled directly to the crt horizontal deflection plates.

Timing Switches

The Normal and Delayed Sweep Timing Switches contain the resistors and capacitors that set the sweep rate and holdoff period. Both timing switches are the same except for the VARIABLE TIME/DIV. control, R160Y and the hold off circuit which is not required in the delayed sweep. In the NORM. position of the MODE switch, R160Y is connected to the normal sweep timing resistor R160. In all other positions of the MODE switch the control is connected to the delayed sweep timing resistor R260.

The VARIABLE TIME/DIV. control (R160Y) extends the sweep time by reducing the voltage supplied to the timing resistors. When this control is fully clockwise, SW160Y shorts out R160Y and applies —100 volts to the timing resistors. Any other position of the control reduces the —100 volts and reduces the sweep rate. SW160Y also removes the voltage from R160W and the UNCAL. lamp (B160W) so that the lamp is off in the calibrated position.

NOTES

SECTION 5

MAINTENANCE

Preventive Maintenance

Preventive Maintenance for the Type 3B3 Time Base plug-in unit consists of visual inspection, correction of defects found, and cleaning. The schedule of preventive maintenance for the Type 3B3 depends upon environment. A Type 3B3 roughly used in a hot, humid, or dirty atmosphere needs more frequent maintenance than would an instrument used in an air conditioned laboratory. The Type 3B3 should be re-calibrated after every 500 hours of operation or every six months if the instrument is used intermittently. Give the Type 3B3 a thorough visual inspection as a preliminary procedure before re-calibration to minimize other preventive maintenance.

Visual Inspection

Remove the plug-in unit from the Oscilloscope cabinet. Look for loose screws, knobs, or broken connections; cracks in components; improperly seated tubes or transistors, and scorched wires or components. For most visible defects the repair method is obvious, but if scorched wires or components are found, usually other trouble is indicated. Find and correct the cause of overheating. Install new parts as outlined under Removal and Replacement of Parts.

Cleaning

Loosen and remove dust on the chassis and around the front panel controls with a clean, dry 1 inch paint brush. Vacuum out any remaining loose dust. If a vacuum cleaner is not available, blow the dust from the equipment with dry, low pressure air, taking care not to damage delicate parts. Areas stained by smoke or oily atmosphere may be cleaned with a cloth dampened with water and a small amount of detergent. Use a cotton swab for cleaning hard-to-get-at places. Be careful not to misplace parts or short leads together.

Removal and Replacement of Parts

Replacement of parts in the Type 3B3 requires only standard techniques in most cases and only a normal amount of care is required. Whenever a part is replaced, re-calibration of the 3B3 may be required and is covered in the "Calibration" section of this book. Replacement of parts unique to Tektronix equipment or requiring special care is covered in the following parapgraphs.

Tube and Transistor Replacement

Do not change tubes or transistors unless they are defective. When a good tube or transistor is removed from a socket it must be returned to the same socket, otherwise it may be necessary to recalibrate the instrument. Use pretested high quality tubes and transistors if replacement is necessary.

Removal of Part Requiring Soldering

In Tektronix instruments, a special silver-bearing solder is used to establish a bond to the silver alloy coated notches in the ceramic terminal strips. This bond may be broken by repeated use of ordinary tin-lead solder. However, occasional use of ordinary 60-40 solder will not break the bond if excess heat is not used. Use a soldering iron with a rating of 75 watts or less. If several Tektronix instruments are maintained, a stock of solder that contains about 3% silver should be kept on hand. This type of solder is used in printed-circuit work and is generally available locally. Or, it can be purchased from Tektronix in one-pound rolls; order by part number 251-514.

Many components in Tektronix instruments are mounted on ceramic terminal strips. Because of the shape of the terminal notches in the ceramic strips, use a wedge-shaped tip on the soldering iron when installing or removing parts. Be sure the tip of the soldering iron is well tinned. Before tinning the iron, file smooth all surfaces to be tinned. This prevents solder from building up on rough spots where it will oxidize. Tin only the first $1/16$ to $1/8$ of the tip. Use solder containing about 3% silver.

Use the following procedure to remove or install parts on ceramic strips.

1. Use needle-nose pliers as a heat sink between the soldering point and the component being installed or removed.

2. Use normal care when manipulating parts and leads.

3. Touch one corner of the iron tip to the notch where you want to solder. Apply enough heat to make the solder flow freely. Do not wedge the soldering iron tip into the terminal notches as the ceramic material is brittle.

Ceramic Strip Replacement

Unsolder all connections, then use a $3/8$" diameter by 3" long plastic or hardwood dowel and a small (2 to 4 oz.) mallet to knock the yoke pins out of the chassis. Place one end of the dowel on the end of the yoke pin protruding through the chassis and rap the opposite end of the dowel smartly with the mallet. When both yokes of the strip to be removed have been loosened in this fashion, the strip is removed as a unit. The spacers will probably come out with the yokes. If not, they can be pulled out separately. An alternate method of removing the terminal strip is to use diagonal cutters to cut off the side of the yoke that holds the ceramic strip. The ceramic strip is removed and the yokes pulled from the chassis with a pair of pliers. Replacement ceramic strips are supplied with yokes and spacers and the old yokes need not be salvaged.

When the damaged strip and yoke assembly has been removed, place new spacers in the holes in the chassis. Using the mallet and dowel, tap the new yoke pins down thoroughly in the spacers. Be sure that these pins are driven completely through the spacers. You may wish to cut off any portion of the yoke pin that protrudes through the spacers with a pair of diagonal cutters. Fig. 5-1 shows how the parts of the ceramic terminal strip fit together.

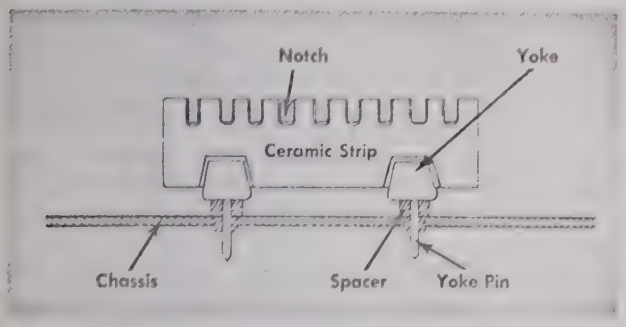


Fig. 5-1. Ceramic strip assembly details.

Switch Replacement

Single wafers are normally not replaced on the switches used in the Type 3B3. If one wafer is defective, the entire switch should be replaced. Removal and replacement of defective switches is generally a pretty obvious procedure. When resoldering it is important to use only enough solder to hold leads. Don't let solder run into a contact and ruin its spring pressure. Replacement switches may be ordered from Tektronix either wired or unwired.

Ordering Replacement Parts

Replacement parts can be ordered from your Tektronix Field Engineering office. Tektronix manufactures most of the mechanical parts and some of the electronic components used in the Type 3B3. The remainder of the electronic components are usually off-the-shelf items that can be purchased locally. Each mechanical and electrical part in the Type 3B3 has a six-digit Tektronix part number. This number and a description of the parts are found in the parts list. When ordering parts, check the parts list to determine Tektronix part number, value rating, and tolerance required. Include the following information when ordering parts:

1. A description of the part.
2. The Tektronix part number.
3. The instrument type and serial number.

As an example, a typical resistor would be ordered as follows:

R54, 3.9 K, ¼ watt fixed, 5%, part number _____, for Type 3B3 Time-Base Plug-In serial _____. Parts ordered in this way are shipped promptly.

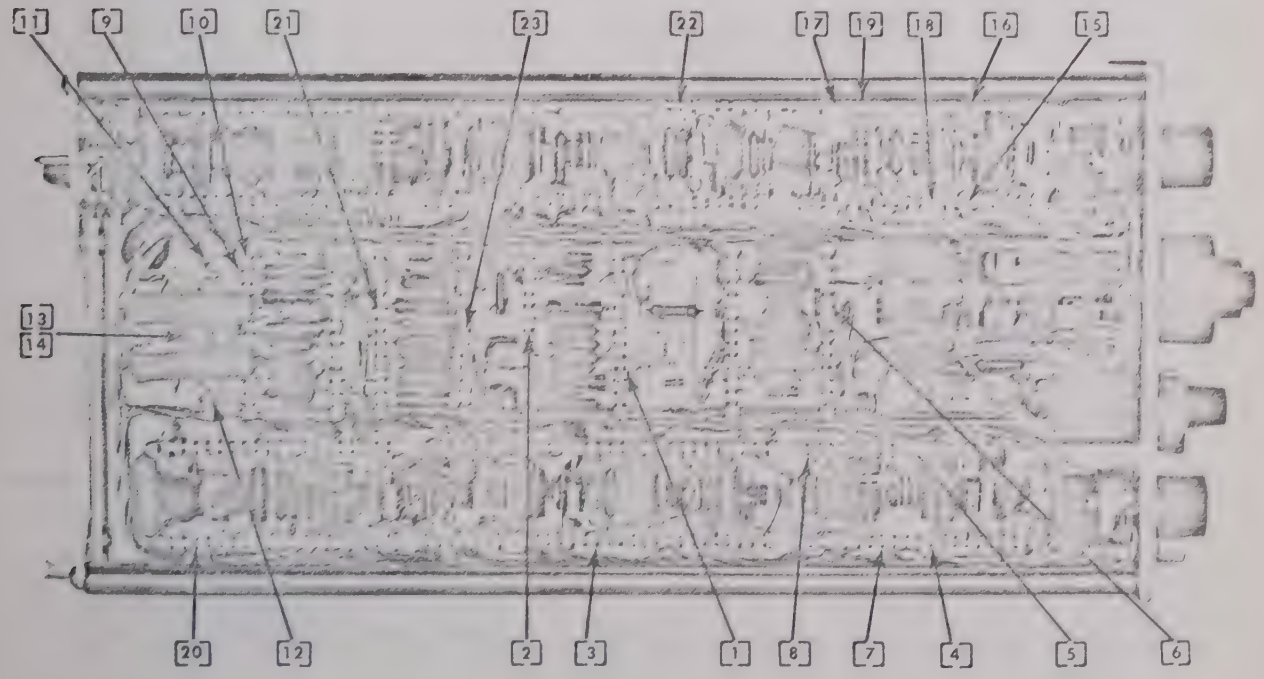


Fig. 5-2. Left side of Type 3B3 illustrating test points designated in Table 5-2.

Troubleshooting

This portion of the manual is provided as a guide in the event trouble develops in the Type 3B3 Time-Base plug-in unit. During troubleshooting procedures, the information in this section should be compared with appropriate sections of this manual, particularly the circuit description and calibration sections.

General Information

Before attempting any troubleshooting work, you should check all controls for proper settings. If you are in doubt about control settings you should review the Operating Information section of this manual. Check to see that the power is on. When you have ascertained that a trouble does exist in the instrument, you can then proceed to isolate the defective circuit using the procedures contained later in this section.

In general, troubleshooting consists of two parts; circuit isolation and circuit troubleshooting. Visual inspection and checking control operation will frequently indicate the defective circuit. Normal or abnormal operation of each control helps identify the nature of a trouble. Trouble that occurs only in certain control positions can frequently be found from the indications given. Feel for irregularities in control operation, listen for unusual sounds, and visually check the entire instrument. Table 5-1 lists possible troubles and the circuits to check in each case. If the defective circuit cannot be isolated by visual inspection and operation of controls, make voltage and waveform measurements within the circuits themselves. Once the defective circuit is isolated, troubleshoot the circuit by making detailed checks within the circuit as outlined in Table 5-2.

Circuit Diagrams

Separate circuit diagrams for each circuit are included in the back of this manual. The circuit diagrams show the reference designation of each component (C39, C44, etc.) as well as important voltages and waveforms. The following is a list of reference designations for each different circuit.

Reference Designation	Circuit Diagram
1 through 49	Normal Sweep Trigger
50 through 99	Delayed Sweep Trigger
100 through 199	Normal Sweep Generator
200 through 299	Delayed Sweep Generator
300 through 399	Horizontal Amplifier
400 through 499	Delay Pickoff

Switch Wafer Code

Switch wafers shown on the circuit diagrams are coded to indicate the position on the actual switches. The number portion of the code refers to the wafer number on the switch assembly. Wafers are numbered from the front of the switch to the rear. The letters F and R show whether the front or rear of the wafer is used.

Test Equipment Required

Reference is made in several places in the troubleshooting procedures to the use of an oscilloscope to check waveforms. Because of the short times involved in many waveforms, it is necessary to use a wide-band oscilloscope such as a Tektronix Type 540 Series with Type K or L plug-in. In addition, an acurately calibrated 20,000 ohm per volt multimeter and a plug-in extension cable (TEKTRONIX Part No. 012-066) are needed. The use of a transistor curve-tracer is optional.

Circuit Isolation

Table 5-1 lists several indications of trouble and the individual circuits to check in each case. When the trouble has been isolated to a particular circuit, refer to Table 5-2 for a guide in troubleshooting within the individual circuits.

TABLE 5-1

Circuit Isolation

Symptom	Circuits to Check
1. No sweep in any position of front-panel controls.	Horizontal Amplifier. Normal Sweep Generator
2. No sweep in DLY'D SWP. positions of MODE switch.	Delayed Sweep Generator Delay Pickoff Circuit
3. No intensified area on display in either INTEN. positions of MODE switch.	Delayed Sweep Generator Plug-in will not intensify normal sweep display when located in left hand (vertical) plug-in opening.
4. Sweep too short in both Normal and Delayed sweep.	Horizontal Amplifier
5. Sweep is short in Delayed sweep positions of MODE switch.	Delayed Sweep Generator
6. Sweep non-linear in Normal and Delayed Sweep.	Horizontal Amplifier
7. Sweep Timing incorrect in all positions of TIME/DIV. switch.	Normal Sweep Generator
8. Sweep Timing incorrect only in some positions of TIME/DIV. switch.	Normal Sweep Generator
9. No sweep in AC or DC trigger coupling, sweep in AUTO but not triggerable.	Normal Sweep Trigger
10. No Delayed Sweep in either TRIG. positions of MODE switch.	Delayed Sweep Trigger

NOTE

Because the Normal and Delayed Sweep circuits are similar, trouble can often be isolated to one or the other by operating each independently. The Delayed sweep can be free run without the Normal Sweep operating by intermittently shorting across R243 in the Delayed Sweep Generator Circuit.

Individual Circuit Checks

Table 5-2 is given as a troubleshooting guide once the trouble has been isolated to an individual circuit.

TABLE 5-2

Individual Circuit Checks

Symptom	Checks
Normal Sweep Generator	
1. No sweep	1. If B164 is lighted, check V161. 2. CRT may be blanked. Check V194, Q183, and Q194. Miller circuit check. Set TIME/DIV. and DELAY TIME RANGE switches to 2 mSEC. Remove Q114; voltage at test point 1 should be —3 volts. Momentarily remove V152; voltage at test point 1, Fig. 5-2, should rise to +10 volts. If it does not, check V161 and D171. Return Q114 and V152 to their sockets. 4. Sweep gating check. Remove Q114, connect voltmeter across R146 (test points 2 and 3). Push COUPLING switch to AUTO. voltmeter should read between 2.9 and 3 volts. Turn LEVEL control to mid-range (1 volt external trigger signal required); voltage should drop to 2.3 volts. 5. Check of D105. Set trigger COUPLING switch to DC. Turn LEVEL control fully CW. Connect test scope probe to test point 3. Intermittently short across R143; switching of tunnel diode D105 should be seen on test scope.
2. Sweep in AUTO coupling only. Not triggerable.	1. Check D101 shorted, D102 open.
3. No sweep in AUTO coupling.	1. Check D119, Q115, and Q125.
4. Sweep non-linear at slow sweep ratios.	1. Check V152 for heater cathode leakage.
5. Sweep non-linear at all sweep rates.	Check V161 for non-linear amplification.
Normal Trigger Circuit	
1. Display cannot be triggered.	1. Use test scope to check for triggering signal at test points 4 and 5.
	2. Voltage at test point 6 should vary from —10 to +14 as LEVEL control is turned through range. 3. Voltage at test point 7 should vary from —9 to +3 as LEVEL control is turned through range. Move the SLOPE switch to the opposite polarity and repeat measurement at test point 7. The two measurements at test point 7 check Q24 and Q34.
	4. Measure voltage on test point 8. Voltage should read about —12.5 volts. This checks Q44. Connect test scope to test point 8. Display should be a square-wave as shown on schematic. This checks D35.
2. Triggers only on large signals.	1. V13 gassy, weak. 2. D35 Defective
3. Triggering unstable.	1. Check oscilloscope power supply regulations.
Horizontal Amplifier	
1. No Sweep.	1. Measure voltage at test point 9, vary POSITION control, voltage should change from —6.5 to —15 volts. 2. Voltage at test point 10 should change from —6.5 to —15 when POSITION control is turned. 3. Voltage at test points 11 and 12 should vary between +2 and +7 as POSITION control is turned. 4. Connect test scope alternately to test points 13 and 14. Waveform shown on schematic should be seen.
2. Sweep will not cover width of CRT.	1. Check SWP CAL. adjustment. Check Q354, and V383.
Delay Pickoff	
1. No delayed sweep.	1. Place MODE switch in any position except NORMAL. Adjust controls for display. Connect test scope probe to test point 20; waveform shown on schematic should be seen. If waveform is incorrect, check V414, V194B, D415, and Q424.
Delayed Sweep Generator	
1. No delayed sweep.	1. If B264 is lighted, check V261. 2. If CRT is blanked, check Q283, and Q294. 3. Miller circuit check. Remove Q214; voltage at test point 21 should be 4.5 volts. Remove V252; voltage at test point 21 should rise to +10 volts. If it does not, check V261. Return Q214 and V252 to socket. 4. Sweep Gating check. Connect test scope probe to test point 32, switching of D205 should be seen. If it is not, Q245 may be open, or D205 defective.
2. No Delayed sweep in TRIG. INTEN. or TRIG. DLY'D SWP. position of MODE switch.	1. Check D202 and D201.

Symptom	Checks
3. Delayed sweep non-linear at all sweep rates.	1. Check V261 for non-linear amplification.
4. Delayed sweep non-linear at slow sweep rates.	1. Check V252 for heater cathode leakage.
5. Trace not intensified in INTEN. positions of MODE switch.	1. Q294 defective.
Delayed Sweep Trigger	
1. Delayed sweep cannot be triggered.	1. Use test scope to check for triggering signal at test points 15 and 16. 2. Voltage at test point 17 should vary from —10 to +14 volts as the Delayed Sweep LEVEL control is turned through its range. 3. Voltage at test point 18 should vary from —9 to +3 volts as the Delayed Sweep LEVEL control is turned through its range (be sure MODE switch is in TRIG. DLY'D SWP). 4. Voltage at test point 19 should be about —12.5 volts. 5. Connect test scope probe to test point 19. Waveform seen should be a square-wave as shown on schematic. This checks D85.
2. Delayed sweep triggers only on large signals.	1. V63 possibly weak. D85 possibly open.

NOTES

SECTION 6

CALIBRATION PROCEDURE

General

The Type 383 Time Base should be calibrated after each 500 hours of operation, or at least every six months. Also, when transistors, tubes, and other components are changed, the calibration of the circuit under repair should be checked.

Some troubles can be caused by changes in component values. These troubles can often be found by checking the calibration of the suspected circuit.

The instructions that follow are in proper sequence to calibrate the instrument and avoid unnecessary repetition of checks and adjustments.

Equipment Required

The following items of equipment, or their equivalent, are required for a complete calibration of the Type 383 Time Base:

1. Type 561A or 567 Oscilloscope.
2. Vertical Amplifier Plug-In Unit (non-sampling type).
3. Time-Mark Generator with crystal-controlled markers at 1 μsec, 10 μsec, 50 μsec, 100 μsec, 1 msec, 5 msec, 10 msec, 100 msec, and 1 sec. The generator must also have an accurate 10 mc sine-wave output. Tektronix Type 180A Time-Mark Generator recommended.
4. A Tektronix 560-series plug-in extension, Part No. 013-034.
5. A coax cable about 3 feet long with UHF plug connectors on each end. Tektronix 42" 50 Ω cable, Part No. 012-001, available.
6. Dc voltmeter, 20,000 ohms per volt, 3% accuracy.
7. Insulated screwdriver for adjusting variable capacitors, such as Jaco 1½" shank No. 125, Tektronix Part No. 003-000.
8. A 6" clip lead with a small insulated alligator clip on each end.
9. Two 18" banana-to-banana patch cords Tektronix PC18R, Part No. 012-031, available.

Preliminary

Install the Vertical Amplifier plug-in unit into the oscilloscope. Install the Type 383 Time Base unit using the special plug-in extension mentioned above. Turn on the oscilloscope, and obtain an AUTO operated normal sweep trace at 5 mSEC/DIV. Then set the Type 383 front-panel controls as follows:

POSITION	midrange
MODE	NORM.
5X MAG	Off (pushed in)
TIME/DIV.	5 mSEC
DELAYED SWEEP	5 mSEC
VARIABLE TIME/DIV.	CALIB.
DELAY TIME	5.00

Allow a 15-minute warmup before starting calibration.

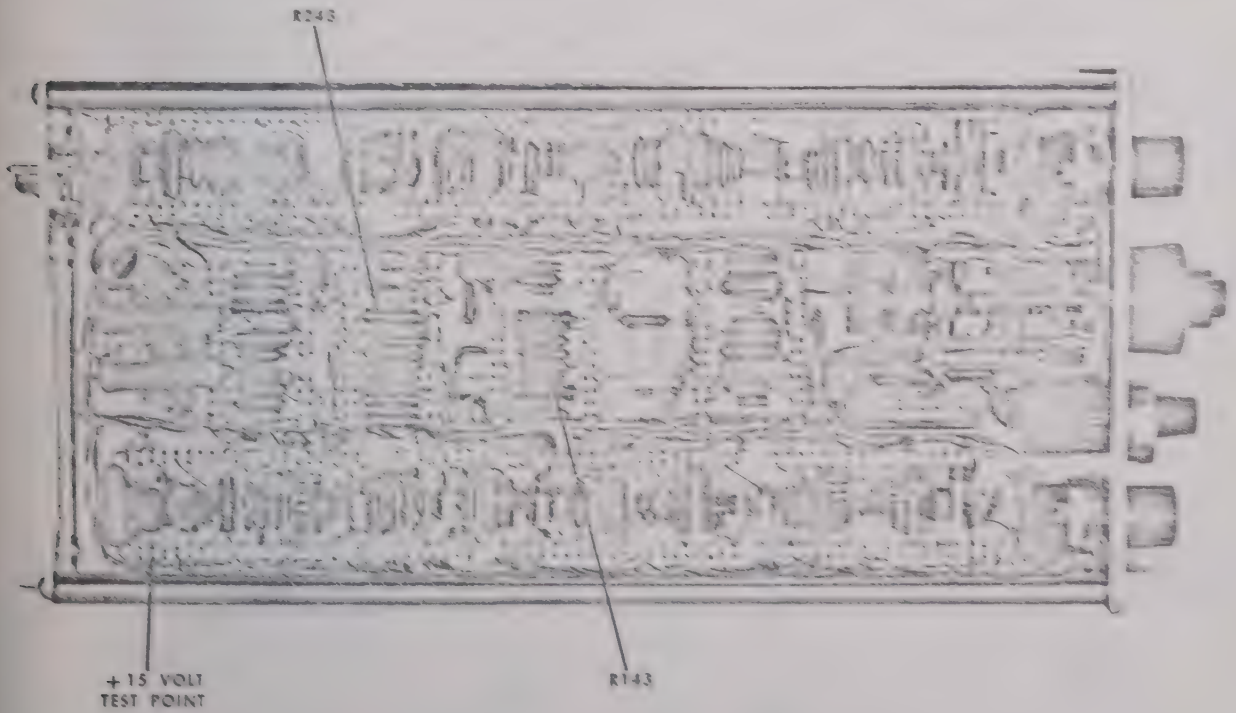


Fig. 6-1. Left side of Type 383. See steps 1, 2, and 3 of calibration procedure.

Procedure

1. Check +15-volt Supply

Use the dc voltmeter and measure the voltage across D398, located on the Type 3B3 left rear side (see Fig. 6-1). The voltage should be +15 volts, ±15%.

2. NORMAL SWP. GATING THRESHOLD Control, R130

Set the NORMAL SWEEP COUPLING switch to AC. Connect the short clip lead (with insulated alligator clips) across R143. R143 is located on the left side, about center, (see Fig. 6-1.) Adjust R130, the NORMAL SWP. GATING THRESHOLD control to just produce a free-running trace. R130 is located at the right rear of the Type 3B3; see Fig. 6-2.

Remove the jumper from R143; the trace should disappear.

3. DELAYED SWP. GATING THRESHOLD Control, R230

Set the Normal Sweep COUPLING switch to AUTO. The trace should appear. Set the MODE switch to TRIG. DLY'D SWP. connect the short clip lead across R243 (see Fig. 6-1).

Adjust R230, the DELAYED SWP. GATING THRESHOLD control, to just produce a free-running trace. R230 is located at the top right rear of the Type 3B3; see Fig. 6-2.

Remove the jumper from R243; the trace should disappear.

4. SWEEP CAL. Control, R312.

Set the MODE switch to NORM., the Normal Sweep SOURCE switch to INT., the COUPLING switch to AUTO, the SLOPE switch to +, and the TIME/DIV. switch to 1 mSEC. Set the Delayed Sweep SOURCE switch to INT., the COUPLING switch to AC, the SLOPE switch to +, and the DELAY SWEEP knob to 1 mSEC.

Connect the Time-Mark Generator to the Vertical Amplifier, and set the generator for 1-msec time-marks.

Adjust the SWEEP CAL. control, (front-panel screwdriver adjustment) for exactly one time marker per major graticule division.

Set the MODE switch to TRIG. DLY'D SWP. and check the timing accuracy. Readjust the SWEEP CAL. control to reduce any timing error by 50 percent. Set the MODE switch to NORM. and see if now the Normal Sweep has a timing error equal and opposite to the Delayed Sweep timing error. The final adjustment of the SWEEP CAL. control is when any basic timing errors of the two sweep generators are equal and opposite.

NOTE

Timing adjustments should always be made with the trace beginning at the left edge of the graticule markings. Make visual measurements between the 1st division line and the 9th division line.

5. NORMAL SWEEP LENGTH Control, R168

Use the same set-up as in step 4, and adjust R168, the NORMAL SWEEP LENGTH control, for 10.5 major divisions of deflection.

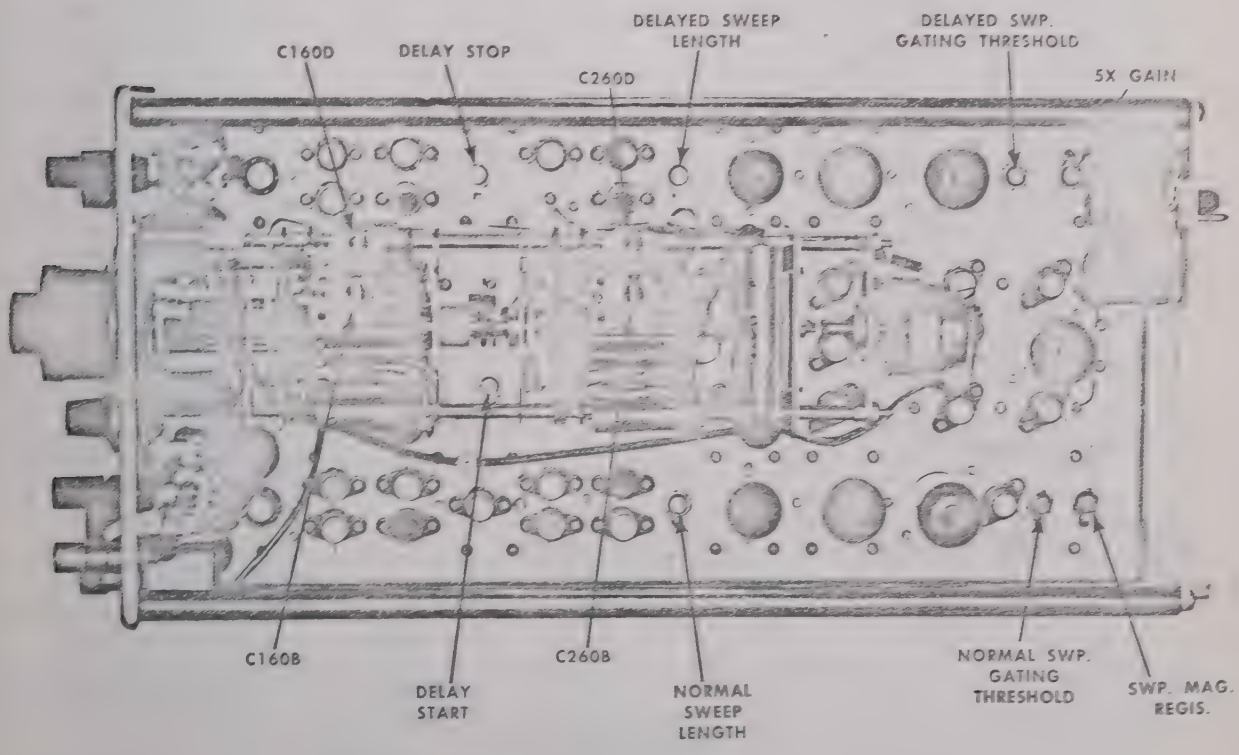


Fig. 6-2. Right side of Type 3B3 with locations of internal adjustments.

6. DELAYED SWEEP LENGTH Control, R268

Use the same set-up as in step 4. Set the MODE switch to TRIG. DLY'D SWP., the TIME/DIV. switch to 2 mSEC, the DELAYED SWEEP knob to 1 mSEC, and adjust the Delayed Sweep LEVEL control for a stable display. Adjust R268, the DELAYED SWEEP LENGTH control, for 10.5 major divisions of deflection.

7. 5X GAIN Control, R355

Set the MODE switch to NORM., and the TIME/DIV. switch to 1 mSEC. Set the Time-Mark Generator for 1-msec and 100-μsec time marks. Adjust the Normal Sweep LEVEL control for a stable display. Pull the 5X MAG. switch out and adjust R355, 5X GAIN, for one large time mark every 5 major divisions and 2 small time marks every major division. Check the linearity over the entire magnified sweep by moving the POSITION control throughout its range.

8. SWP. MAG. REGIS. Control, R368

Use the same set-up as in step 7. Pull the 5X MAG. switch out and position the display so that the first large time mark falls on the center line of the graticule. Push the 5X MAG. switch in and adjust R368, the SWP. MAG. REGIS. control, so that the first time mark again falls on the center line of the graticule. Repeat this adjustment until there is no shift in the start of the display when the 5X MAG. switch is pulled out.

9. DELAY START and DELAY STOP

Set the front-panel controls as follows:

MODE switch	INTEN.
TIME/DIV.	1 mSEC
DELAYED SWEEP	10 μSEC.

Set the Time-Mark Generator for 1-msec time mark and adjust the Normal Sweep LEVEL control for a stable display. Turn the DELAY TIME control to 1.00 and adjust DELAY START, R430, until the bright part of the display just passes to the right of the second time mark. Next, turn the DELAY TIME control to 9.00 and adjust DELAY STOP, R439, until the brightened part of the display just passes to the right of the tenth time mark. With the DELAY TIME control at 9.00, turn the MODE switch to DLY'D SWP., and adjust DELAY STOP, R439, until the peak of the time mark is just at the left side of the crt. Return the DELAY TIME control to 1.00 and adjust DELAY START, R430, to set the peak of the time mark at the left side of the crt. Because these two controls interact, you may have to repeat this adjustment several times.

10. Normal and Delay Sweep Rates

Set the front-panel controls as follows:

MODE	NORM.
TRIGGERING (Normal Sweep)	+ AC INT.
TRIGGERING (Delayed Sweep)	+ AC INT.
TIME/DIV.	50 μsec.
DELAYED SWEEP knob	50 μsec.

Set the Time-Mark Generator for 50-μsec time marks. Adjust the Normal Sweep LEVEL control for a stable display. Check for 1 time mark for each major graticule division between the 2nd and 9th division lines. Set the MODE switch to TRIG. DLY'D SWP. and adjust the Delayed Sweep LEVEL control for a stable display. Check for 1 time mark for each major graticule division between the 2nd and 9th division lines.

Make the above check at each of the settings shown in Table 6-1. Notice that the TIME/DIV. and DELAYED SWEEP switches are set to the same position for each check.

TABLE 6-1

TIME/DIV. and DELAYED SWEEP controls	TIME-MARKS	MARKS/DIVISION
50 μSEC	50 μsec	1
.1 mSEC	100 μsec	1
.2 mSEC	100 μsec	2
.5 mSEC	500 μsec	1
1 mSEC	1 msec	1
2 mSEC	1 msec	2
5 mSEC	5 msec	1
10 mSEC	10 msec	1
20 mSEC	10 msec	2
50 mSEC	50 msec	1
.1 SEC	100 msec	1
.2 SEC	100 msec	2
.5 SEC	500 msec	1
1 SEC	1 sec	1

NOTE

The over-all timing error for all sweep rates must be within 3% (1.2 minor div.). Timing checks are made over 8 major divisions of the graticule between the 1st and the 9th division lines.

11. VARIABLE TIME/DIV. Control

Set the MODE switch to NORM., the TIME/DIV. switch to 1 mSEC, the DELAYED SWEEP knob to .2 mSEC, and the Time-Mark Generator for 10-msec time marks. Obtain a triggered display of a time marker at the left and right edges of the graticule.

Rotate the VARIABLE TIME/DIV. control fully counterclockwise. The display should now be at least 4 time marks, a ratio of at least 2.5 to 1.

Set the TIME-MARK Generator for 1-msec time marks. The VARIABLE TIME/DIV. control should now affect the display in all five positions of the MODE switch. In the two INTEN positions the VARIABLE TIME/DIV only controls the length of the intensified area.

12. Fast Normal Sweep Rates

Remove the plug-in extension, and install the Type 3B3 directly into the oscilloscope. Set the VARIABLE TIME/DIV. control to CALIB. Set the Time-Mark Generator, TIME/DIV. switch, and adjustments as shown in Table 6-2.

TABLE 6-2

TIME/DIV.	Time-Mark Generator	Adjustment	Marks/Div.
10 μSEC	10 μsec	C160D	1
20 μSEC	10 μsec	check	2
5 μSEC	5 μsec	check	1
1 μSEC	1 μsec	C160B	1
2 μSEC	1 μsec	check	2
.5 μSEC	1 μsec	check	1 per 2 div.
.5 μSEC	10 megacycles	Pull 5X MAG.	1 cycle/div.

NOTE

Over-all timing accuracy must be within 3% (1.2 minor div.)

13. Fast Delayed Sweep Rates

Set the MODE switch to TRIG. DLY'D SWP. Using Table 6-2, substitute DELAYED SWEEP knob settings for the TIME/DIV. settings. At 10 μSEC, adjust C260D, and at 1 μSEC, adjust C260B. Check the 10-megacycle display the same as for the Normal Sweep.

14. Single Sweep

Set the Time-Mark Generator for 1-msec time marks. Set the TIME/DIV. switch to 1 mSEC, the MODE switch to NORM, the Normal Sweep COUPLING switch to AC, and adjust the LEVEL control for a stable display. Then turn the Normal Sweep LEVEL control fully counterclockwise. Push the NORM.-SINGLE SWEEP-RESET switch to RESET and release; the ready lamp should turn on. Watch the crt, and slowly turn the LEVEL control clockwise. One sweep should occur and the ready lamp should turn off.

SECTION 7
PARTS LIST AND SCHEMATICS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

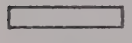
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

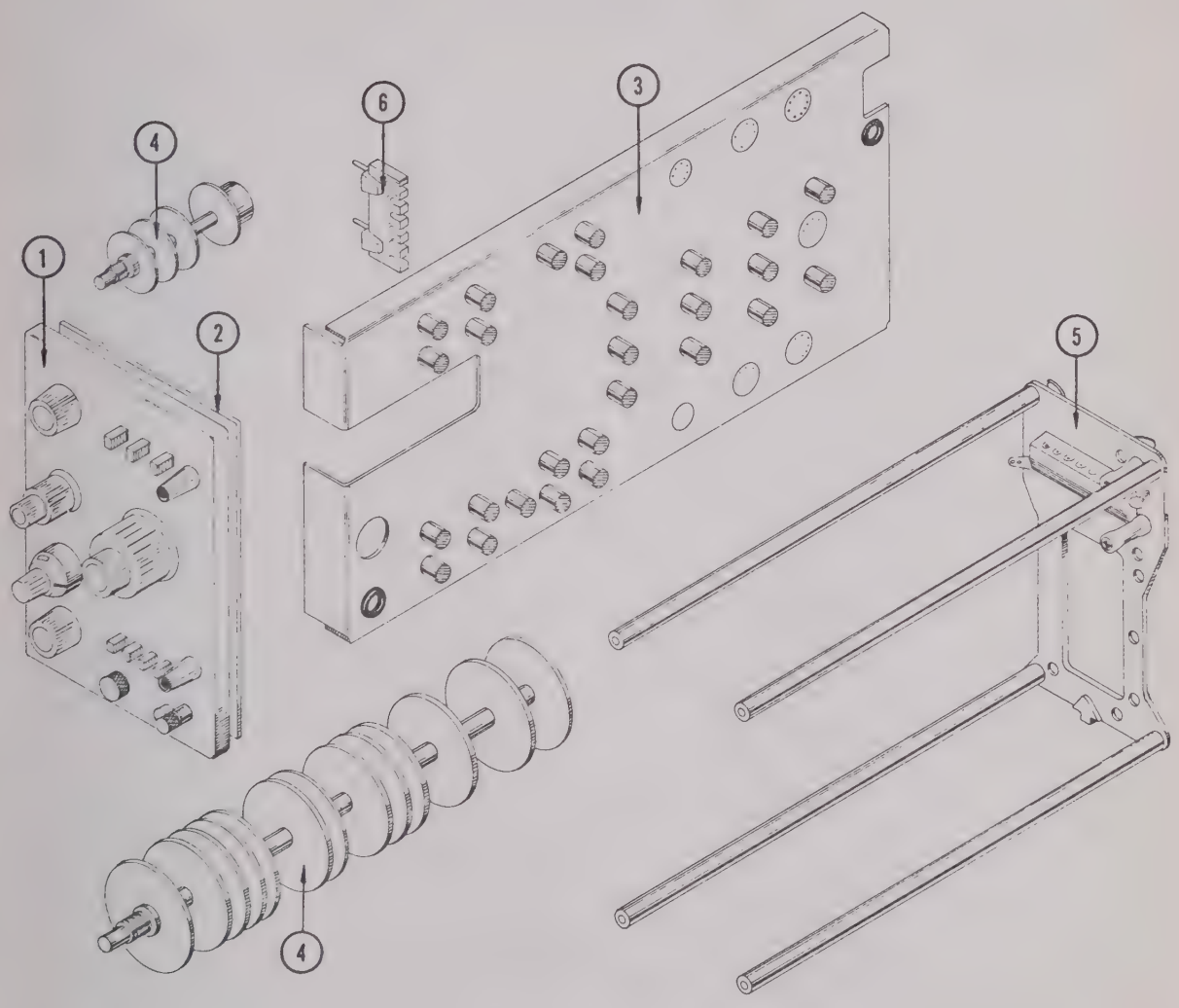
ABBREVIATIONS AND SYMBOLS

a or amp	amperes
BHS	binding head steel
C	carbon
cer	ceramic
cm	centimeter
comp	composition
cps	cycles per second
crt	cathode-ray tube
CSK	counter sunk
dia	diameter
div	division
EMC	electrolytic, metal cased
EMT	electroyltic, metal tubular
ext	external
f	farad
F & I	focus and intensity
FHS	flat head steel
Fil HS	fillister head steel
g or G	giga, or 10^9
Ge	germanium
GMV	guaranteed minimum value
h	henry
hex	hexagonal
HHS	hex head steel
HSS	hex socket steel
HV	high voltage
ID	inside diameter
incd	incandescent
int	internal
k or K	kilohms or kilo (10^3)
kc	kilocycle
m	milli, or 10^{-3}
mc	megacycle
mm	millimeter
meg or M	megohms or mega (10^6)
met.	metal
μ	micro, or 10^{-6}
n	nano, or 10^{-9}
Ω	ohm
OD	outside diameter
OHS	oval head steel
p	pico, or 10^{-12}
PHS	pan head steel
piv	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
Prec	precision
PT	paper tubular
PTM	paper or plastic, tubular, molded
RHS	round head steel
rms	root mean square
sec	second
Si	silicon
S/N	serial number
t or T	tera, or 10^{12}
TD	toroid
THS	truss head steel
tub.	tubular
v or V	volt
Var	variable
w	watt
w/	with
w/o	without
WW	wire-wound

SPECIAL NOTES AND SYMBOLS

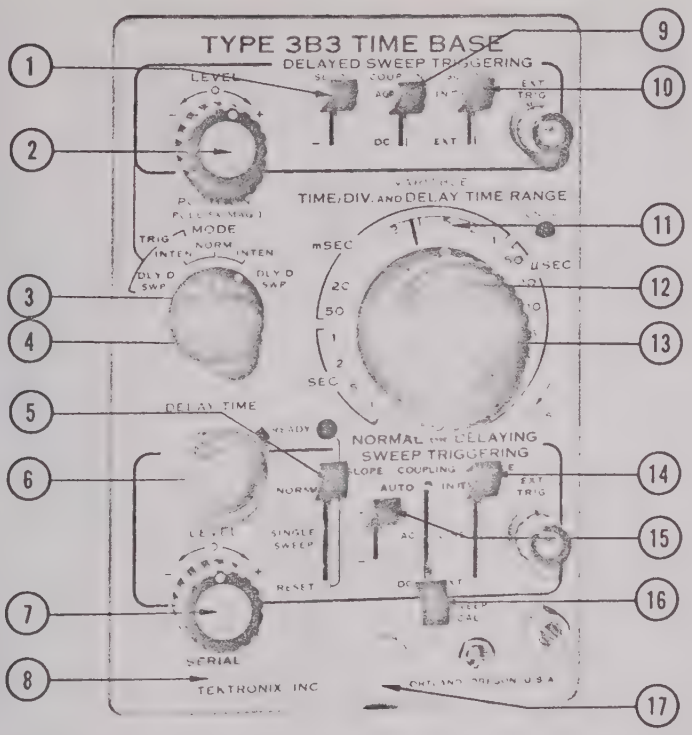
X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

LOCATOR



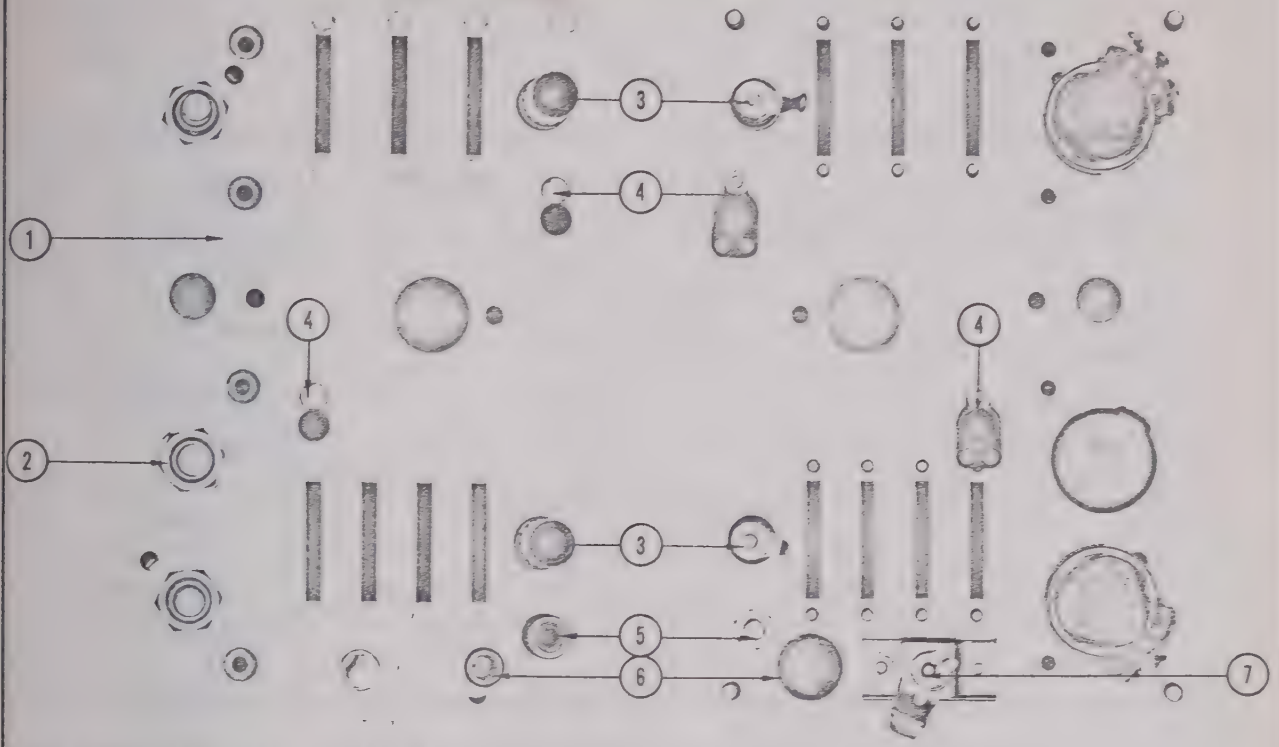
REF. NO.	PART NO	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	Pg. 7-3				Knobs and Front Group
2	Pg. 7-4				Subpanel Group
3	Pg. 7-5				Chassis Group
4	Pg. 7-7				Switches
5	Pg. 7-9				Rear and Frame Group
6	Pg. 7-10				Ceramic Strips

KNOBS AND FRONT GROUP



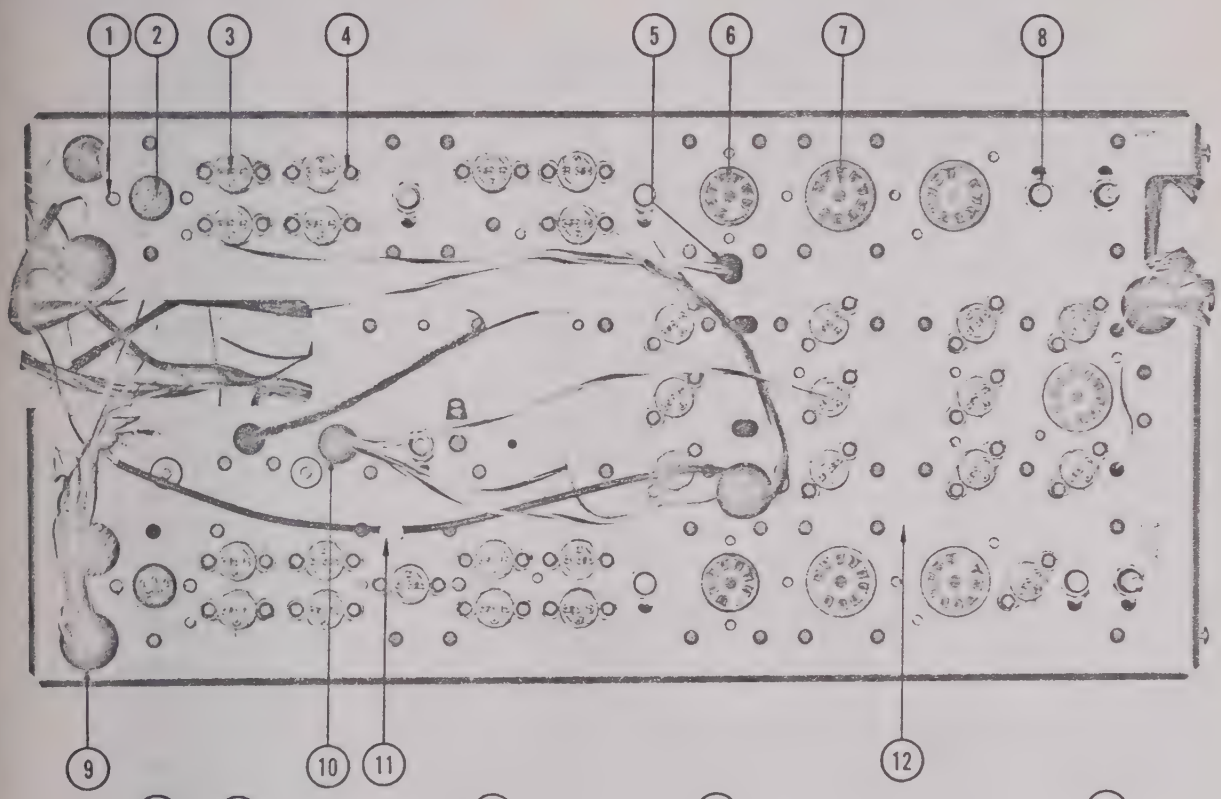
REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	366-215			1	KNOB, SLOPE, charcoal
2	366-191			1	KNOB, EXT. TRIG. ATTEN., charcoal
3	366-175			1	KNOB, MODE, charcoal
4	366-189	101	1569	1	KNOB, POSITION, red
	366-262	1570		1	KNOB, POSITION, red
5	366-215			1	KNOB, RESET, Single, Normal, charcoal
6	331-096			1	DIAL, with charcoal knob
7	366-191			1	KNOB, EXT. TRIG. ATTEN., charcoal
8	333-737			1	PANEL, front
9	366-215			1	KNOB, AC-DC, charcoal
10	366-215			1	KNOB, INT.-EXT., charcoal
11	331-092			1	DIAL, clear plexiglas
12	366-194			1	KNOB, DELAYED SWEEP
13	366-038			1	KNOB, VARIABLE, red
14	366-215			1	KNOB, INT.-LINE-EXT., charcoal
15	366-215			1	KNOB, SLOPE, charcoal
16	366-215			1	KNOB, AUTO-AC-DC, charcoal
17	366-109			1	KNOB, securing, anodized alum.

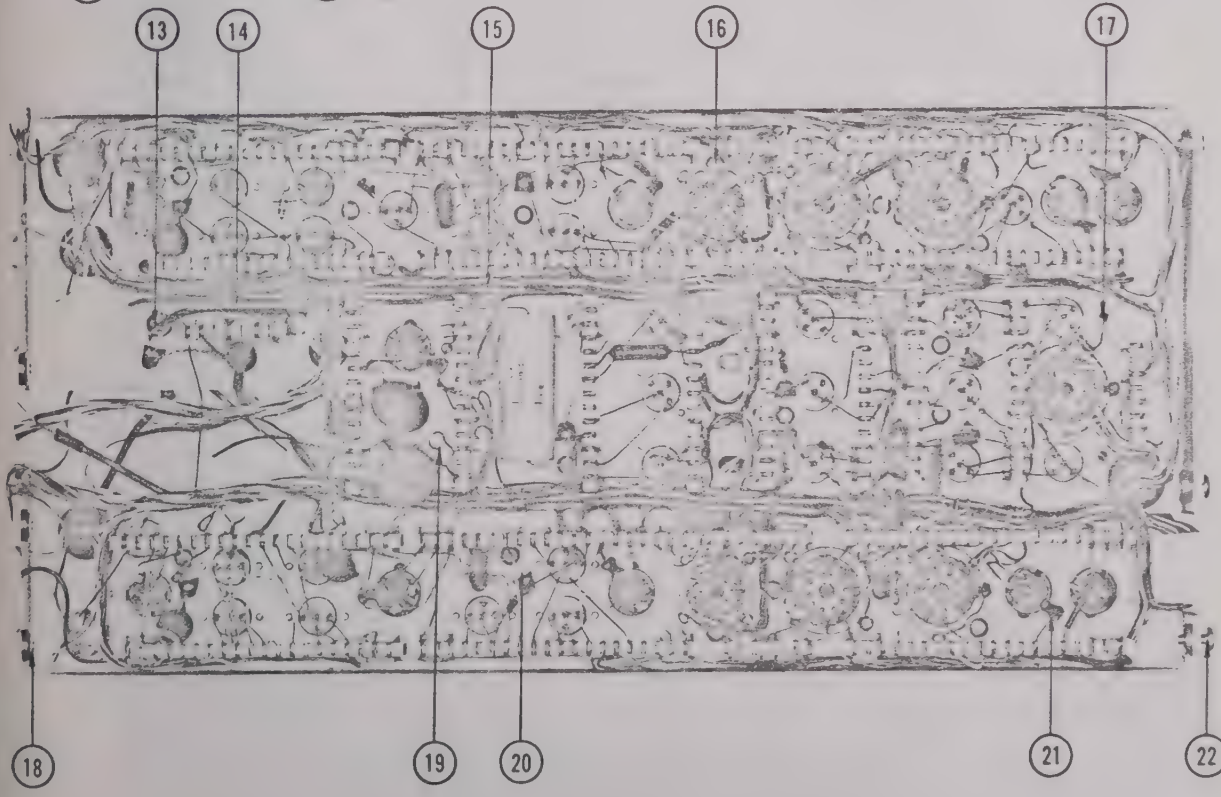
SUBPANEL GROUP



REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	387-728			1	PLATE, subpanel, front
2	210-413			3	NUT, hex, brass, 3/8-32 x 1/2 in.
	210-840			3	WASHER, steel, .390 ID x 9/16 OD
	210-012			3	LOCKWASHER, steel, pot, internal 3/8 x 1/2 in.
3	129-065			2	POST, binding, assembly
					Consisting of:
	119-064			1	POST, binding, miniature fluted, 5 way, charcoal
	210-408			2	NUT, hex, brass, 6-32 x 5/16 in.
	358-181			1	BUSHING, nylon, charcoal
	210-206			2	LUG, solder, SE6, long
4	352-008			2	HOLDER, melamine, neon bulb
	211-031			2	SCREW, 4-40 x 1 in. FHS
	210-406			4	NUT, hex, brass, 4-40 x 3/16 in.
5	129-020			1	POST binding, BPN 13, assembly
					Consisting of:
	200-072			1	CAP, BPN13
	210-010			1	LOCKWASHER, steel, internal #10
	210-410			1	NUT, hex, brass, 10-32 x 5/16 in.
	355-503			1	STEM, BPN13
	210-206			1	LUG, solder, SE10, long (not shown)
6	358-075			1	BUSHING, brass, .343 OD x 1/4-32 in.
	337-558			1	SHIELD, brass, .562 OD x 7/8 in. long
7	214-052			1	FASTENER, pawl right, with stop
	210-004			2	LOCKWASHER, steel, internal #4
	210-406			2	NUT, hex, brass, 4-40 x 3/16 in.

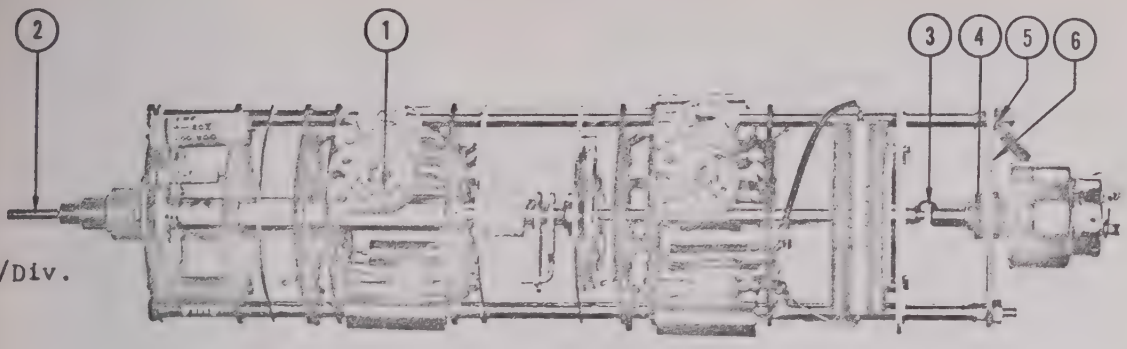
CHASSIS GROUP



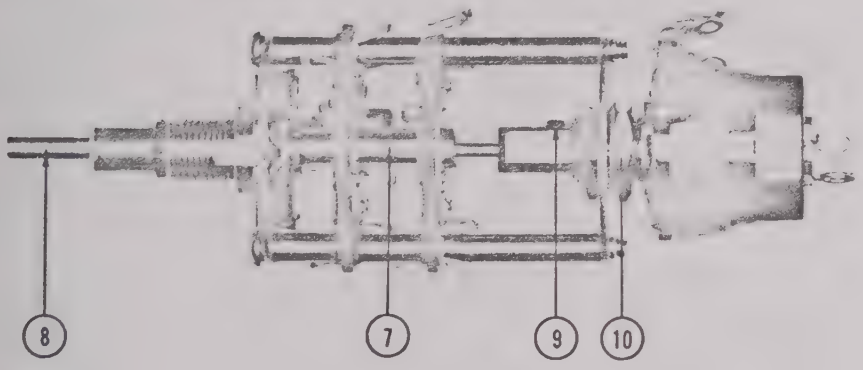


CHASSIS GROUP

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	213-055			4	SCREW, thread cutting, 2-56 x 5/16 in. RHS, phillips
2	136-101			2	SOCKET, 5 pin
3	136-095	101	2109	28	SOCKET, 4 pin, transistor
	136-181	2110		22	SOCKET, 3 pin transistor snap in
	136-182	2110		6	SOCKET, 3 pin transistor snap in
4	213-113	101	2109	56	SCREW, 2-32 x 5/16 in. RHS, phillips
	354-234	2110		28	RING, socket
5	348-002			2	GROMMET, rubber, 1/4 in.
6	136-008			2	SOCKET, STM7G
7	136-015			5	SOCKET, STM9G
8	210-583			8	NUT, hex, brass, 5/16 x 1/4-32 in.
	210-046			8	LOCKWASHER, steel, .400 OD x .261 ID
9	348-005			4	GROMMET, rubber, 1/2 in.
10	348-003			1	GROMMET, rubber, 5/16 in.
11	385-099			1	ROD, nylon, 1/4 dia. x 5/8 in.
12	441-465			1	CHASSIS
13	211-504			2	SCREW, 6-32 x 1/4 in. BHS
	210-202			1	LUG, solder, SE6, with 2 wire holes
14	337-532			1	SHIELD, alum. 1 3/4 x 7/16 x 1 1/4 in.
15	179-703			1	CABLE harness
16	213-044			25	SCREW, thread cutting, 5-32 x 3/16 in. Pan H steel
17	348-031			2	GROMMET, polyurethane, snap in, 1/4 in. dia.
18	211-538			4	SCREW, 6-32 x 5/16 in. RHS 100° CSK, phillips (not shown)
19	343-043			6	CLAMP, for neon bulbs
20	210-201			12	LUG, solder, SE4
21	210-223			6	LUG, solder, 1/4 in. hole
22	211-507			3	SCREW, 6-32 x 5/16 in. BHS



Time/Div.

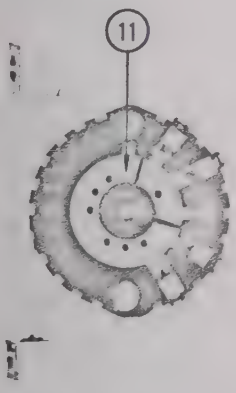


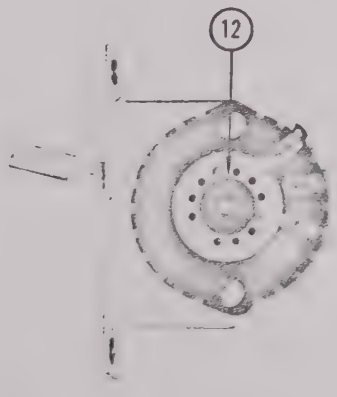
Mode

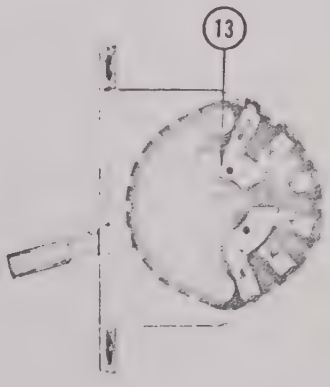
Slope

AC - DC

Int. - Ext.



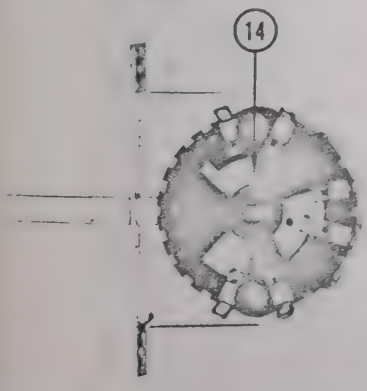


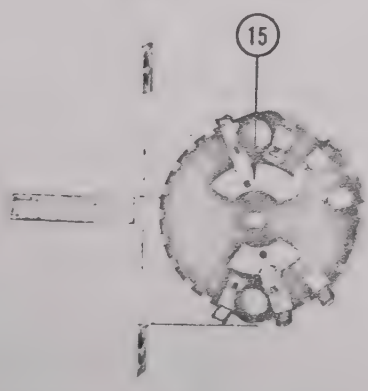


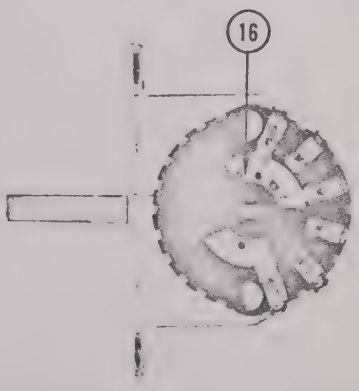
Normal - Single - Reset

Auto - AC - DC

Int. - Line - Ext.



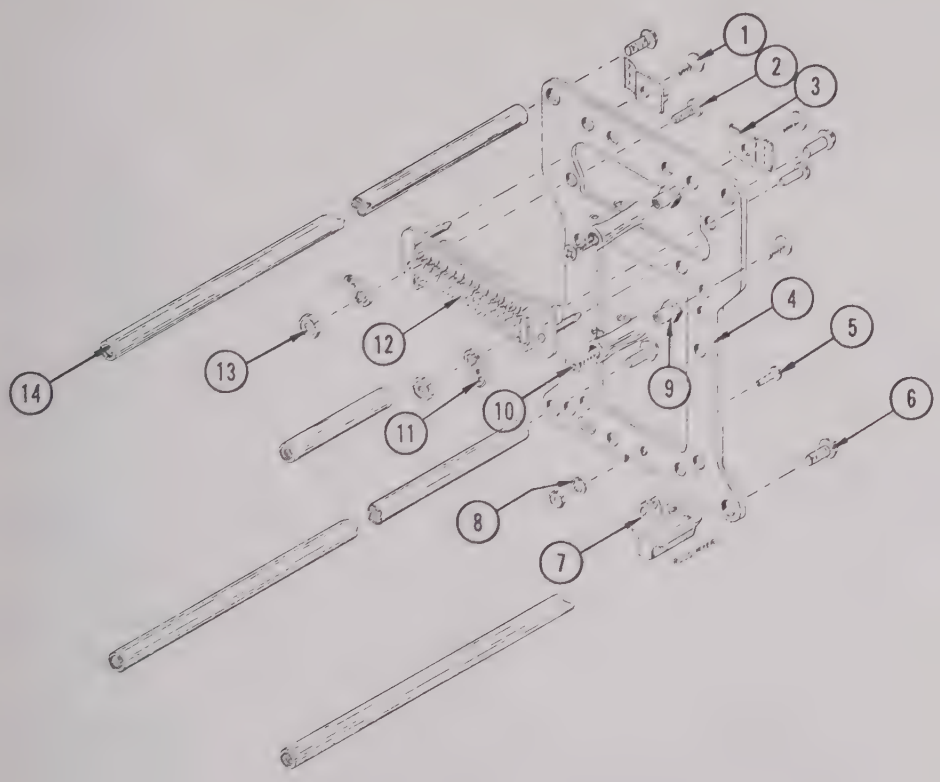




SWITCHES

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	262-529			1	SWITCH, TIME/DIV. wired
					Includes:
2	384-260			1	ROD, extension, 1/8 dia. x 9 3/8 in. long
3	376-014			1	COUPLING, wire
4	210-413			2	NUT, hex, brass, 3/8-32 x 1/2 in.
5	210-449			2	NUT, hex, brass, 5-40 x 1/4 in.
	210-006			1	LOCKWASHER, steel, internal #6
	210-202			1	LUG, solder, SE6 with 2 wire holes
6	386-450			1	PLATE, alum. 15/16 x 2 5/16 in.
	260-505			1	SWITCH, TIME/DIV. unwired
					Mounting Hardware: (not included)
	210-579			1	NUT, switch mounting, 5/8-24 x 3/4 in. (not shown)
	210-049			1	LOCKWASHER, brass, internal 5/8 in. (not shown)
7	262-498			1	SWITCH, MODE, wired
					Includes:
8	384-237			1	ROD, extension, 3 in. long
9	213-048			1	SCREW, set, 4-40 x 1/8 in. HHS, allen head
10	210-413			2	NUT, hex, brass, 3/8-32 x 1/2 in.
	210-012			1	LOCKWASHER, steel, pot, internal 3/6 x 1/2 in.
	260-456			1	SWITCH, MODE, unwired
					Mounting Hardware: (not included)
	210-413			1	NUT, hex, brass, 3/8-32 x 1/2 in.
	210-840			1	WASHER, steel, .390 ID x 9/16 in. OD (not shown)
11	260-472			2	SWITCH, SLOPE, unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x 3/16 in.
	210-006			2	LOCKWASHER, steel, internal #6
12	260-473			1	SWITCH, AC-DC, unwired
					Mounting hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x 3/16 in.
	210-006			2	LOCKWASHER, steel, internal #6
13	260-474	101	1999	1	SWITCH, INT.-EXT. unwired
	260-640	2000		1	SWITCH, INT.-LINE-EXT. unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x 3/16 in.
	210-006			2	LOCKWASHER, steel, internal #6
14	260-477			1	SWITCH, NORMAL-SINGLE-RESET, unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x 3/16 in.
	210-006			2	LOCKWASHER, steel, internal #6
15	260-475			1	SWITCH AUTO.-AC-DC, unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x 3/16 in.
	210-006			2	LOCKWASHER, steel, internal #6
16	260-476			1	SWITCH, INT.-LINE-EXT. unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x 3/16 in.
	210-006			2	LOCKWASHER, steel, internal #6

REAR AND FRAME GROUP

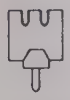


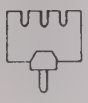
REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	211-507			3	SCREW, 6-32 x 5/16 in. BHS
2	211-008			2	SCREW, 4-40 x 1/4 in. BHS
3	214-276			2	SPRING, ground, 29/64 x 1/2 x 1 1/16 in.
4	387-647			1	PLATE, rear, alum. 3-31/32 x 5-31/32 in.
5	211-013			1	SCREW, 4-40 x 3/8 in. RHS
6	212-044			4	SCREW, 8-32 x 1/2 in. RHS, phillips
7	351-037			1	GUIDE, delrin, 5/8 x 13/16 in.
8	210-004			1	LOCKWASHER, steel, internal #4
9	210-478			2	NUT, hex, alum. 5/16 x 21/32 in.
10	211-544			2	SCREW, 6-32 x 3/4 in. truss HS, phillips
11	210-201			2	LUG, solder, SE4
12	131-149			1	CONNECTOR, chassis mount, 24 contact
13	210-406			3	NUT, hex, brass, 4-40 x 3/16 in.
14	384-566	100	1109	4	ROD, frame, spacing
	384-615	1110		4	ROD, frame, spacing

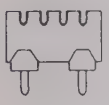
CERAMIC STRIPS AND MOUNTINGS

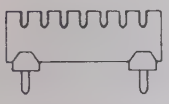
3/4 inch

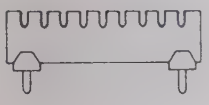
1 notch 124-100

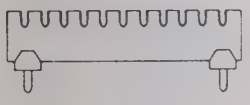

2 notch 124-086


3 notch 124-087


4 notch 124-088


7 notch 124-089


9 notch 124-090


11 notch 124-091

7/16 inch

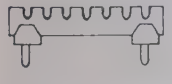
1 notch 124-118

2 notch 124-119

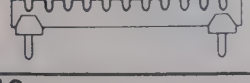
3 notch 124-092

4 notch 124-120

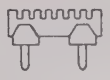
5 notch 124-093

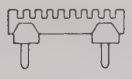

7 notch 124-094

9 notch 124-095

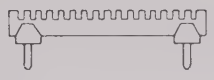

11 notch 124-106

7/16 inch SMALL NOTCH —Short Stud


7 notch 124-149

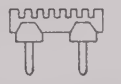

9 notch 124-148

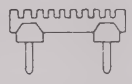
13 notch 124-147

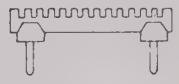

16 notch 124-146

20 notch 124-145

7/16 inch SMALL NOTCH —Tall Stud


7 notch 124-158


9 notch 124-157


13 notch 124-156

16 notch 124-155

20 notch 124-154

MOUNTINGS

Stud, nylon, short..355-046

Stud, nylon, tall .. 355-082

Spacer, $^{11}/_{32}$ inch..361-039

Spacer, $^{3}/_{8}$ inch .. 361-009

Spacer, $^{1}/_{4}$ inch...361-008

Spacer, $^{5}/_{32}$ inch...361-007

Ceramic strips include studs, but spacers must be ordered separately by part no.

ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description				S/N Range
		Bulbs				
B10	150-027	Neon, NE-23				
B60	150-027	Neon, NE-23				
B134	150-027	Neon, NE-23			READY	
B149	150-027	Neon, NE-23				
B160W	150-027	Neon, NE-23			UNCAL.	
B164	150-027	Neon, NE-23				
B264	150-027	Neon, NE-23				
		Capacitors				

Tolerance ±20% unless otherwise indicated.
Tolerance of all electrolytic capacitors as follows (with exceptions):

3 V — 50 V = −10%, +250%
51 V — 350 V = −10%, +100%
351 V — 450 V = −10%, +50%

C4	283-041	.0033 μf	Disc Type	500 v	5%	
C5	283-068	.01 μf	Disc Type	500 v		
C7	281-560	198 pf	Cer.	500 v	10%	100-149
	281-543	270 pf	Cer.	500 v	10%	150-up
C9	281-586	25 pf	Cer.	500 v	5%	
C11	283-000	.001 μf	Disc Type	500 v		
C13	283-003	.01 μf	Disc Type	150 v		
C16	283-003	.01 μf	Disc Type	150 v		X1030-up
C18	283-003	.01 μf	Disc Type	150 v		
C37	283-026	.2 μf	Disc Type	25 v		
C39	281-543	270 pf	Cer.	500 v	10%	
C55	283-068	.01 μf	Disc Type	500 v		
C57	281-560	198 pf	Cer.	500 v	10%	100-149
	281-543	270 pf	Cer.	500 v	10%	150-up
C59	281-586	25 pf	Cer.	500 v	5%	
C61	283-000	.001 μf	Disc Type	500 v		
C63	283-003	.01 μf	Disc Type	150 v		
C66	283-003	.01 μf	Disc Type	150 v		X1030-up
C68	283-003	.01 μf	Disc Type	150 v		
C87	283-026	.2 μf	Disc Type	25 v		
C89	281-524	150 pf	Cer.	500 v		
C106	283-026	.2 μf	Disc Type	25 v		
C109	281-525	470 pf	Cer.	500 v		
C113	281-518	47 pf	Cer.	500 v		X2319-up
C115	290-175	10 μf	EMT	35 v		
C118	283-026	.2 μf	Disc Type	25 v		
C137	281-523	100 pf	Cer.	350 v		
C148	281-524	150 pf	Cer.	500 v		

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Capacitors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description				S/N Range
C149	Use 283-057	.1 μf	Disc Type	100 v		
C152	281-546	330 pf	Cer.	500 v	10%	
C160A	281-505	12 pf	Cer.	500 v	10%	
C160B	281-010	4.5-25 pf	Cer.	Var.		
C160C	283-534	82 pf	Mica	500 v	5%	
C160D	281-010	4.5-25 pf	Cer.	Var.		
C160E	*295-069	.001 μf	Timing Series†			
C160F		.01 μf				
C160G		.1 μf				
C160H		1 μf				
C162	283-003	.01 μf	Disc Type	150 v		
C163	281-511	22 pf	Cer.	500 v	10%	X2319-up
C167	281-524	150 pf	Cer.	500 v		
C170A	281-523	100 pf	Cer.	350 v		
C170B	285-501	.001 μf	MT	600 v		
C170C	285-569	.01 μf	PTM	200 v		
C170D	285-572	.1 μf	PTM	200 v		
C170E	285-576	1 μf	PTM	100 v	10%	
C170F	281-518	47 pf	Cer.	500 v		
C188	281-573	11 pf	Cer.		10%	
C195	283-004	.02 μf	Disc Type	150 v		
C197	283-003	.01 μf	Disc Type	150 v		
C206	283-026	.2 μf	Disc Type	25 v		
C209	281-525	470 pf	Cer.	500 v		
C215	281-518	47 pf	Cer.	500 v		X2319-up
C237	281-523	100 pf	Cer.	350 v		
C252	281-546	330 pf	Cer.	500 v	10%	100-2318X
C260A	281-505	12 pf	Cer.	500 v	10%	
C260B	281-010	4.5-25 pf	Cer.	Var.		
C260C	283-534	82 pf	Mica	500 v	5%	
C260D	281-010	4.5-25 pf	Cer.	Var.		
C260E	*295-069	.001 μf	Timing Series†			
C260F		.01 μf				
C260G		.1 μf				
C260H		1 μf				
C262	283-003	.01 μf	Disc Type	150 v		
C263	281-511	22 pf	Cer.	500 v	10%	X2319-up
C267	281-524	150 pf	Cer.	500 v		
C303	283-026	.2 μf	Disc Type	25 v		
C336	283-026	.2 μf	Disc Type	25 v		
C354	Use 285-007	160 pf	Glass	500 v	5%	100-2318
C354	281-605	200 pf	Cer.	500 v		2319-up
C356	283-526	.001 μf	Mica	500 v	1%	
C364	283-519	360 pf	Mica	500 v	5%	100-2318
C364	283-551	270 pf	Mica		5%	2319-up
C394	283-026	.2 μf	Disc Type	25 v		
C396	283-006	.02 μf	Disc Type	600 v		
C397	283-006	.02 μf	Disc Type	600 v		

† C160 E, F, G, H and C260 E, F, G, H furnished as a unit.

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Capacitors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description		S/N Range
C399	283-057	.1 μf Disc Type	200 v	
C412	283-004	.02 μf Disc Type	150 v	
C414	283-003	.01 μf Disc Type	150 v	
C417	283-001	.005 μf Disc Type	500 v	
C423	283-003	.01 μf Disc Type	150 v	
C424	283-002	.01 μf Disc Type	500 v	
C427	283-057	.1 μf Disc Type	200 v	
C433	283-026	.2 μf Disc Type	25 v	
C438	283-057	.1 μf Disc Type	200 v	

Diodes

D14	152-141	Silicon	1N3605	X1030-up
D15	152-008	Germanium	T12G	100-1029
D15	*152-061	Silicon	Tek Spec	1030-up
D16	152-008	Germanium	T12G	100-1029
D16	152-141	Silicon	1N3605	1030-up
D24	*152-075	Germanium	Tek Spec	100-1029
D24	152-141	Silicon	1N3605	1030-up
D34	*152-075	Germanium	Tek Spec	100-1029
D34	152-141	Silicon	1N3605	1030-up
D35	152-081	Tunnel	TD2 2.2MA	
D64	152-141	Silicon	1N3605	X1030-up
D65	152-008	Germanium	T12G	100-1029
D65	*152-061	Silicon	Tek Spec	1030-up
D66	152-008	Germanium	T12G	100-1029
D66	152-141	Silicon	1N3605	1030-up
D74	*152-075	Germanium	Tek Spec	100-1029
D74	152-141	Silicon	1N3605	1030-up
D84	*152-075	Germanium	Tek Spec	100-1029
D84	152-141	Silicon	1N3605	1030-up
D85	152-081	Tunnel	TD2 2.2MA	
D101	*152-075	Germanium	Tek Spec	
D102	*152-075	Germanium	Tek Spec	
D105	152-093	Tunnel	TD3 4.7 MA	
D113	*152-075	Germanium	Tek Spec	
D119	*152-075	Germanium	Tek Spec	
D125	*152-075	Germanium	Tek Spec	
D138	*152-075	Germanium	Tek Spec	
D162	152-091	Zener	1N982 75 v	
D170	*152-061	Silicon	Tek Spec	
D171	*152-061	Silicon	Tek Spec	
D172	*152-061	Silicon	Tek Spec	
D189	*152-075	Germanium	Tek Spec	
D195	*152-061	Silicon	Tek Spec	
D198	*152-075	Germanium	Tek Spec	
D201	*152-075	Germanium	Tek Spec	
D202	*152-075	Germanium	Tek Spec	
D205	152-093	Tunnel	TD3 4.7 MA	
D213	*152-075	Germanium	Tek Spec	
D238	*152-075	Germanium	Tek Spec	
D262	152-091	Zener	1N982 75 v	

Diodes *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description	S/N Range
D270	*152-061	Silicon Tek Spec	
D292	152-075	Germanium Tek Spec	
D398	152-031	Zener 1N718A 15 v	
D415	152-081	Tunnel TD2 2.2 MA	

Inductors

L35	*108-146	5 μh	
L85	*108-146	5 μh	
L149	*108-054	6.4 μh	X1810-up
L303	108-249	12 μh	

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R7	315-753	75 k	¼ w		5%	
R9	301-914	910 k	½ w		5%	
R10	301-275	2.7 meg	½ w		5%	
R11	315-224	220 k	¼ w		5%	
R12	316-101	100 Ω	¼ w			
R13	316-102	1 k	¼ w			
R14	303-243	24 k	1 w		5%	
R16	301-623	62 k	½ w		5%	
R17	315-124	120 k	¼ w		5%	
R18	316-470	47 Ω	¼ w			
R19	316-824	820 k	¼ w			
R20	315-562	5.6 k	¼ w		5%	
R21	315-473	47 k	¼ w		5%	100-1029
R21	Use 301-0393-00	39 k	½ w		5%	1030-up
R23†	311-311	200 k		Var.	LEVEL	
R29	303-393	39 k	1 w		5%	100-1029
R29	303-363	36 k	1 w		5%	1030-up
R35	309-345	225 Ω	½ w	Prec.	1%	
R37	316-101	100 Ω	¼ w			
R39	315-270	27 Ω	¼ w		5%	
R44	302-563	56 k	½ w			
R57	315-753	75 k	¼ w		5%	
R59	301-914	910 k	½ w		5%	
R60	301-275	2.7 meg	½ w		5%	
R61	315-224	220 k	¼ w		5%	
R62	316-101	100 Ω	¼ w			
R63	316-102	1 k	¼ w			
R64	303-243	24 k	1 w		5%	
R66	301-623	62 k	½ w		5%	
R67	315-124	120 k	¼ w		5%	
R68	316-470	47 Ω	¼ w			
R69	316-824	820 k	¼ w			
R70	315-562	5.6k	¼ w		5%	
R71	315-473	47 k	¼ w		5%	100-1029
R71	Use 301-0393-00	39 k	½ w		5%	1030-up
R73††	311-311	200 k		Var.	LEVEL	

† Concentric with SW6. Furnished as a unit.
†† Concentric with SW56. Furnished as a unit.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
R79	303-393	39 k	1 w		5%	100-1029
R79	303-363	36 k	1 w		5%	1030-up
R85	309-345	225 Ω	½ w	Prec.	1%	
R87	316-101	100 Ω	¼ w			
R89	315-330	33 Ω	¼ w		5%	
R94	302-563	56 k	½ w			
R102	315-102	1 k	¼ w		5%	
R106	316-470	47 Ω	¼ w			
R108	321-380	88.7 k	⅛ w	Prec.	1%	X2319-up
R109	315-331	330 Ω	¼ w		5%	
R110	315-823	82 k	¼ w		5%	100-2318
R110	321-392	118 k	⅛ w	Prec.	1%	2319-up
R112	302-683	68 k	½ w			
R113	315-222	2.2 k	¼ w		5%	
R114	316-332	3.3 k	¼ w			
R116	316-272	2.7 k	¼ w			
R117	316-101	100 Ω	¼ w			
R118	316-102	1 k	¼ w			
R119	315-681	680 Ω	¼ w		5%	
R120	316-561	560 Ω	¼ w			
R125	301-823	82 k	½ w		5%	
R129	315-472	4.7 k	¼ w		5%	
R130	311-110	100 k		Var.	NORMAL SWP. GATING THRESHOLD	
R131	309-354	45 k	½ w	Prec.	1%	
R132	316-334	330 k	¼ w			
R133	315-752	7.5 k	¼ w		5%	
R134	301-104	100 k	½ w		5%	
R135	319-067	1.21 k	¼ w	Prec.	1%	
R136	319-065	121 k	¼ w	Prec.	1%	
R137	319-063	3.01 k	¼ w	Prec.	1%	
R138	319-068	7.5 k	¼ w	Prec.	1%	
R139	319-070	75 k	¼ w	Prec.	1%	
R140	319-071	806 k	¼ w	Prec.	1%	
R141	319-064	9.76 k	¼ w	Prec.	1%	
R142	309-354	45 k	½ w	Prec.	1%	
R143	319-069	17.8 k	¼ w	Prec.	1%	
R145	319-066	604 Ω	¼ w	Prec.	1%	
R146	319-066	604 Ω	¼ w	Prec.	1%	
R148	316-823	82 k	¼ w			
R149	316-102	1 k	¼ w			
R152	315-221	220 Ω	¼ w		5%	
R160A	309-380	250 k	½ w	Prec.	1%	
R160B	309-380	250 k	½ w	Prec.	1%	
R160C	309-140	500 k	½ w	Prec.	1%	
R160D	323-604	750 k	½ w	Prec.	¼%	
R160E	323-604	750 k	½ w	Prec.	¼%	
R160F	323-603	1.5 meg	½ w	Prec.	¼%	
R160G	309-399	7.5 meg	½ w	Prec.	1%	
R160H	309-399	7.5 meg	½ w	Prec.	1%	
R160W	302-104	100 k	½ w			

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description				S/N Range
R160X	301-103	10 k	½ w			5%	
R160Y†	311-108	20 k		Var.	WW	VARIABLE	
R161	316-101	100 Ω	¼ w				
R162	306-683	68 k	2 w				100-2318
R162	305-433	43 k	2 w			5%	2319-up
R163	316-472	4.7 k	¼ w				X2319-up
R164	315-224	220 k	¼w			5%	
R165	316-101	100 Ω	¼ w				
R167	301-752	7.5 k	½ w			5%	
R168	311-310	5 k		Var.		NORMAL SWEEP LENGTH	
R169	303-153	15 k	1 w			5%	
R170	316-184	180 k	¼ w				
R184	316-182	1.8 k	¼ w				
R186	316-332	3.3 k	¼ w				
R187	315-124	120 k	¼ w			5%	
R188	315-752	7.5 k	¼ w			5%	
R190	316-152	1.5 k	¼ w				
R192	316-470	47 Ω	¼ w				
R194	308-213	25 k	7 w		WW	5%	
R195	302-101	100 Ω	½ w				
R196	302-274	270 k	½ w				
R197	316-121	120 Ω	¼ w				
R198	315-162	1.6 k	¼ w			5%	
R199	316-101	100 Ω	¼ w				X2319-up
R202	315-681	680 Ω	¼ w			5%	
R206	316-470	47 Ω	¼ w				
R209	316-331	330 Ω	¼ w				
R210	315-823	82 k	¼ w			5%	
R212	302-683	68 k	½ w				
R213	315-222	2.2 k	¼ w			5%	
R214	316-332	3.3 k	¼ w				
R229	301-823	82 k	½ w			5%	
R230	311-110	100 k		Var.		DELAYED SWP. GATING THRESHOLD	
R231	309-354	45 k	½ w		Prec.	1%	
R236	319-065	121 k	¼ w		Prec.	1%	
R237	319-063	3.01 k	¼ w		Prec.	1%	
R238	319-068	7.5 k	¼ w		Prec.	1%	
R239	319-070	75 k	¼ w		Prec.	1%	
R240	319-071	806 k	¼ w		Prec.	1%	
R241	319-064	9.76 k	¼ w		Prec.	1%	
R242	309-354	45 k	½ w		Prec.	1%	
R243	319-069	17.8 k	¼ w		Prec.	1%	
R245	319-066	604 Ω	¼ w		Prec.	1%	
R246	319-066	604 Ω	¼ w		Prec.	1%	
R252	315-221	220 Ω	¼ w				100-2318X
R260A	309-380	250 k	½ w		Prec.	1%	
R260B	309-380	250 k	½ w		Prec.	1%	

† Concentric with SW160Y. Furnished as a unit.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description				S/N Range
R260C	309-140	500 k	½ w		Prec.	1%	
R260D	309-141	750 k	½ w		Prec.	1%	
R260E	309-141	750 k	½ w		Prec.	1%	
R260F	309-017	1.5 meg	½ w		Prec.	1%	
R260G	309-399	7.5 meg	½ w		Prec.	1%	
R260H	309-399	7.5 meg	½ w		Prec.	1%	
R261	316-101	100 Ω	¼ w				
R262	306-683	68 k	2 w				100-2318
R262	305-433	43 k	2 w			5%	2319-up
R263	316-472	4.7 k	¼ w				X2319-up
R264	315-224	220 k	¼ w				
R265	316-101	100 Ω	¼ w				
R267	Use 303-752	7.5 k	1 w			5%	
R268	311-310	5 k		Var.		DELAYED SWEEP LENGTH	
R269	303-153	15 k	1 w			5%	
R284	316-182	1.8 w	¼ w				
R286	301-623	62 k	½ w			5%	
R287	315-752	7.5 k	¼ w			5%	
R288	301-473	47 k	½ w			5%	
R292	301-104	100 k	½ w			5%	
R294	316-332	3.3 k	¼ w				
R310	Use 309-392	20 k	½ w		Prec.	1%	
R312	311-326	10 k		Var.		SWP. CAL	
R314	309-343	107 k	½ w		Prec.	1%	
R316†	311-312	150 k		Var.		POSITION	
R317	309-430	60.4 k	½ w		Prec.	1%	
R318	309-426	2.87 k	½ w		Prec.	1%	
R319	309-431	80.6 k	½ w		Prec.	1%	
R323	302-473	47 k	½ w				
R333	302-473	47 k	½ w				
R335	309-100	10 k	½ w		Prec.	1%	
R336	309-388	6 k	½ w		Prec.	1%	
R354	309-345	225 Ω	½ w		Prec.	1%	
R355	311-169	100 Ω		Var.		5X GAIN	
R356	315-330	33 Ω	¼ w			5%	
R357	308-054	10 k	5 w		WW	5%	
R364	319-067	1.21 k	¼ w		Prec.	1%	
R367	308-053	8 k	5 w		WW	5%	
R368	311-310	5 k		Var.		SWP. MAG. REGIS.	
R381	316-101	100 Ω	¼ w				
R382	308-178	15 k	8 w		WW	5%	
R384	316-101	100 Ω	¼ w				
R385	308-178	15 k	8 w		WW	5%	
R391	301-151	150 Ω	½ w			5%	
R392	301-151	150 Ω	½ w			5%	
R393	308-0245-00	.6 Ω	2 w		WW	5%	X3840-up
R394	301-910	91 Ω	½ w			5%	
R396	308-229	4 k	5 w		WW	5%	100-3839
R396	308-0003-00	2 k	5 w		WW	5%	3840-up

† Concentric with SW367. Furnished as a unit.

Resistors (Cont'd)

Ckt. No.	Tektronix Part No.		Description				S/N Range
R397	308-003	2 k	5 w	WW	5%		100-3839X
R398	301-334	330 k	½ w		5%		
R411	316-101	100 Ω	¼ w				
R412	316-101	100 Ω	¼ w				
R413	316-103	10 k	¼ w				
R414	309-118	4.23 k	½ w	Prec.	1%		
R415	309-100	10 k	½ w	Prec.	1%		
R417	315-470	47 Ω	¼ w		5%		
R419	303-223	22 k	1 w		5%		
R423	316-101	100 Ω	¼ w				
R424	315-152	1.5 k	¼ w		5%		
R426	309-432	82.5 k	½ w	Prec.	1%		
R427	309-429	16.5 k	½ w	Prec.	1%		
R428	316-101	100 Ω	¼ w				
R429	309-270	3.92 k	½ w	Prec.	1%		
R430	311-329	50 k		Var.		DELAY START	
R431	309-195	90 k	½ w	Prec.	1%		
R432	309-159	5 k	½ w	Prec.	1%		
R433	309-430	60.4 k	½ w	Prec.	1%		
R434	311-342	50 k		Var.	WW	DELAY TIME	
R436	Use 305-333	33 k	2 w		5%		
R437	309-350	12.4 k	½ w	Prec.	1%		
R438	301-563	56 k	½ w		5%		
R439	311-329	50 k		Var.		DELAY STOP	

Switches

	Unwired	Wired			S/N Range
SW3	260-476		Lever	SOURCE	
SW5	260-475		Lever	COUPLING	
SW6[1]	311-311			PULL EXT. TRIG. ATTEN.	
SW19	260-472		Lever	SLOPE	
SW53	Use *050-211		Lever	SOURCE	100-1999
SW53	260-640		Lever	SOURCE	2000-up
SW55	260-473		Lever	COUPLING	
SW56[2]	311-311			PULL EXT. TRIG. ATTEN.	
SW69	260-472		Lever	SLOPE	
SW81	260-456	*262-498	Rotary	MODE	
SW135	260-477		Lever	SINGLE SWEEP	
SW160[3]	260-505	*262-529	Rotary	TIME/DIV (Normal Sweep)	
SW160Y[4]	311-108				
SW260[3]	260-505	*262-529	Rotary	TIME/DIV (Delayed Sweep)	
SW367[5]	311-312			PULL 5X MAG.	

[1] Concentric with R23. Furnished as a unit.
[2] Concentric with R73. Furnished as a unit.
[3] SW160 and SW260 furnished as a unit.
[4] Concentric with R160Y. Furnished as a unit.
[5] Concentric with R316. Furnished as a unit.

Transformers

T101	*120-278	Toroid TD71	3-8 turn winding
T201	*120-277	Toroid TD70	2-8 turn winding

©

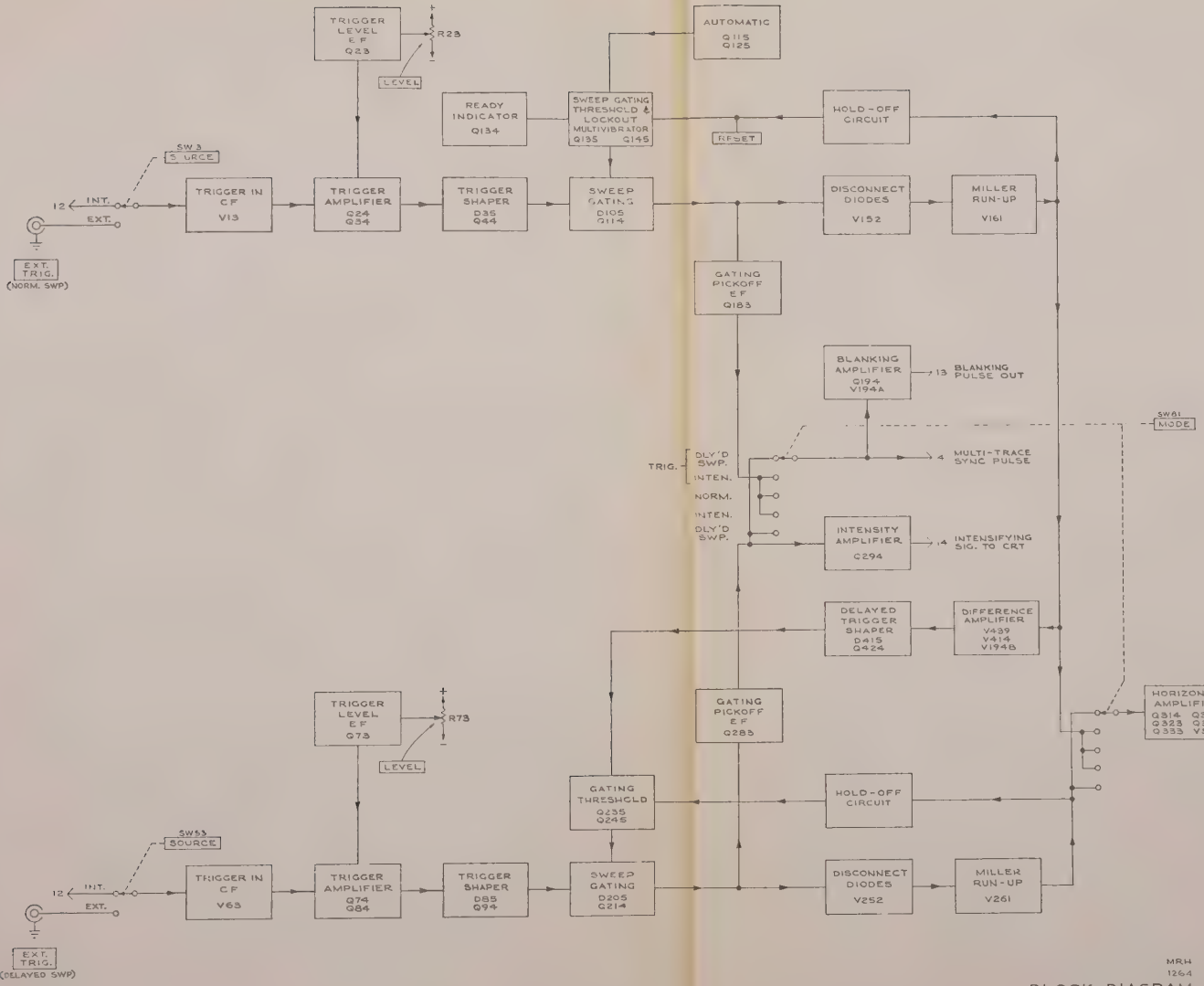
Transistors

Ckt. No.	Tektronix Part No.	Description	S/N Range
Q23	151-070	2N1377	100-1029
Q23	151-063	2N2207	1030-up
Q24	151-084	2N1225	100-1029
Q24	151-063	2N2207	1030-up
Q34	151-084	2N1225	100-1029
Q34	151-063	2N2207	1030-up
Q44	151-094	2N835	100-1029
Q44	*151-108	Replaceable by 2N2501	1030-up
Q73	151-070	2N1377	100-1029
Q73	151-063	2N2207	1030-up
Q74	151-084	2N1225	100-1029
Q74	151-063	2N2207	1030-up
Q84	151-084	2N1225	100-1029
Q84	151-063	2N2207	1030-up
Q94	151-094	2N835	100-1029
Q94	*151-108	Replaceable by 2N2501	1030-up
Q114	*151-062	Selected from TIN101	100-2318
Q114	*151-108	Replaceable by 2N2501	2319-up
Q115	*151-062	Selected from TIN101	
Q124	*151-087	Selected from 2N1131	
Q125	*151-062	Selected from TIN101	
Q134	*151-096	Selected from 2N1893	
Q135	*151-087	Selected from 2N1131	
Q145	*151-087	Selected from 2N1131	
Q183	151-076	2N2048	
Q194	151-076	2N2048	
Q214	*151-062	Selected from TIN101	
Q235	*151-087	Selected from 2N1131	
Q245	*151-087	Selected from 2N1131	
Q283	151-076	2N2048	
Q294	151-094	2N835	100-1029
Q294	*151-108	Replaceable by 2N2501	1030-up
Q314	151-076	2N2048	
Q323	*151-062	Selected from TIN101	100-1029
Q323	*151-108	Replaceable by 2N2501	1030-up
Q333	*151-062	Selected from TIN101	100-1029
Q333	*151-108	Replaceable by 2N2501	1030-up
Q354	151-058	RT5204	100-2318
Q354	*151-103	Replaceable by 2N2219	2319-up
Q364	151-058	RT5204	100-2318
Q364	*151-103	Replaceable by 2N2219	2319-up
Q424	151-058	RT5204	

Electron Tubes

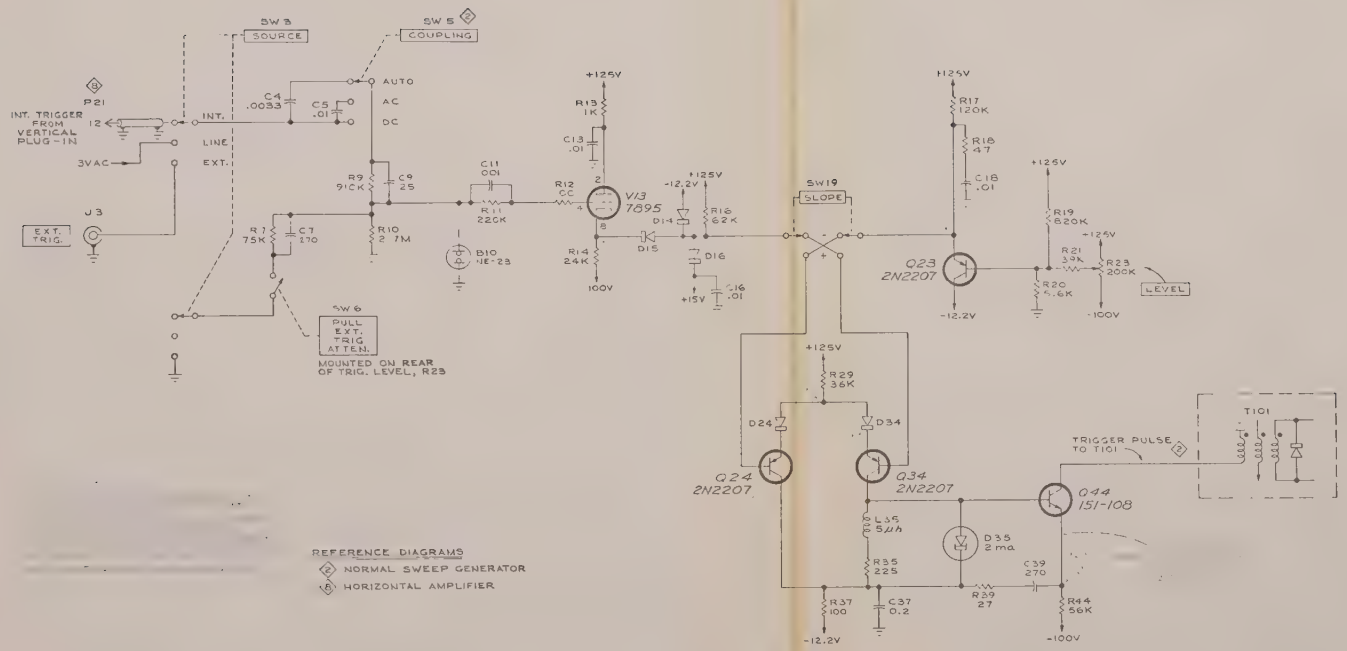
V13	154-378	7895
V63	154-378	7895
V152	154-016	6AL5
V161	154-278	6BL8
V194	154-187	6DJ8
V252	154-016	6AL5
V261	154-278	6BL8
V383	154-187	6DJ8
V414	154-187	6DJ8
V439	154-370	ZZ1000

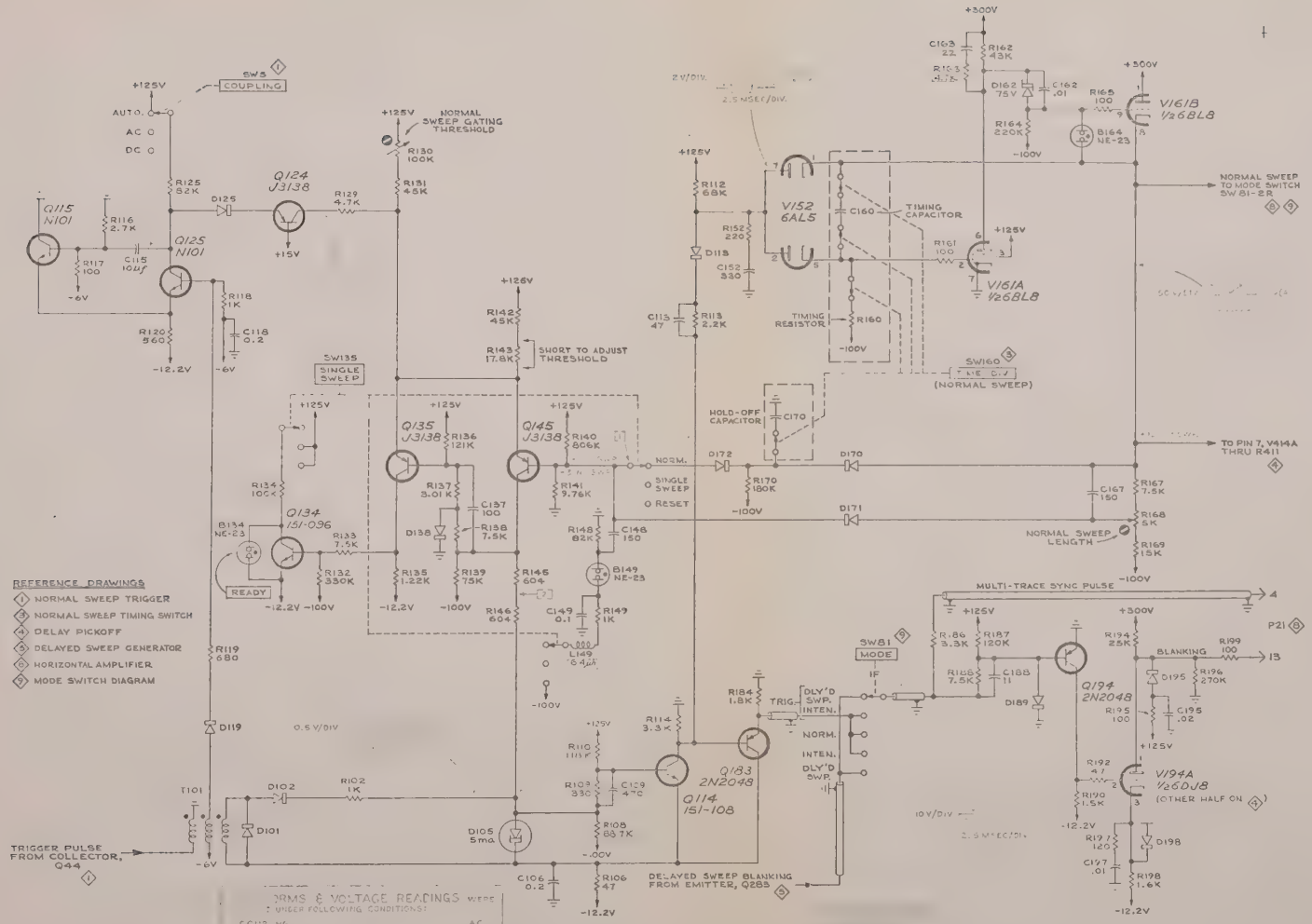
©



MRH
12-64

BLOCK DIAGRAM


SW 3
SOURCE
SW 5
COUPLING
P21
INT. TRIGGER FROM VERTICAL PLUG-IN
INT.
LINE
EXT.
3VAC
AUTO
AC
DC
C4 .0033
C5 .01
R9 91CK
C9 25
J 3
EXT. TRIG.
R7 75K
C7 270
R10 2.7M
SW 6
PULL EXT. TRIG. ATTEN.
MOUNTED ON REAR OF TRIG. LEVEL, R23
C11 001
R11 220K
B10 HE-23
R12 CC
V13 7695
R13 1K
C13 .01
R14 24K
100V
+125V
-12.2V
D14
D15
D16
R16 62K
+15V
C16 .01
SW19
SLOPE
R17 120K
R18 47
C18 .01
Q23 2N2207
R19 820K
R21 39K
R23 200K
LEVEL
R20 5.6K
R29 36K
D24
D34
Q24 2N2207
Q34 2N2207
L35 5μh
D35 2 ma
R35 225
C39 270
R39 27
R37 100
C37 0.2
R44 56K
Q44 151-108
T101
TRIGGER PULSE TO T101
REFERENCE DIAGRAMS
NORMAL SWEEP GENERATOR
HORIZONTAL AMPLIFIER
READINGS WERE
DITION
LEVEL:
UPPER VOLTAGE READING
LOWER VOLTAGE READING
COUPLING
SLOPE
SEE PARTS LIST FOR EARLIER VALUES AND S/N RANGES OF PARTS MARKED WITH BLUE OUTLINE
MRH
1063
NORMAL SWEEP TRIGGER
CIRCUIT NUMBERS 1 THRU 49



† TYPE 383 PLUG-IN

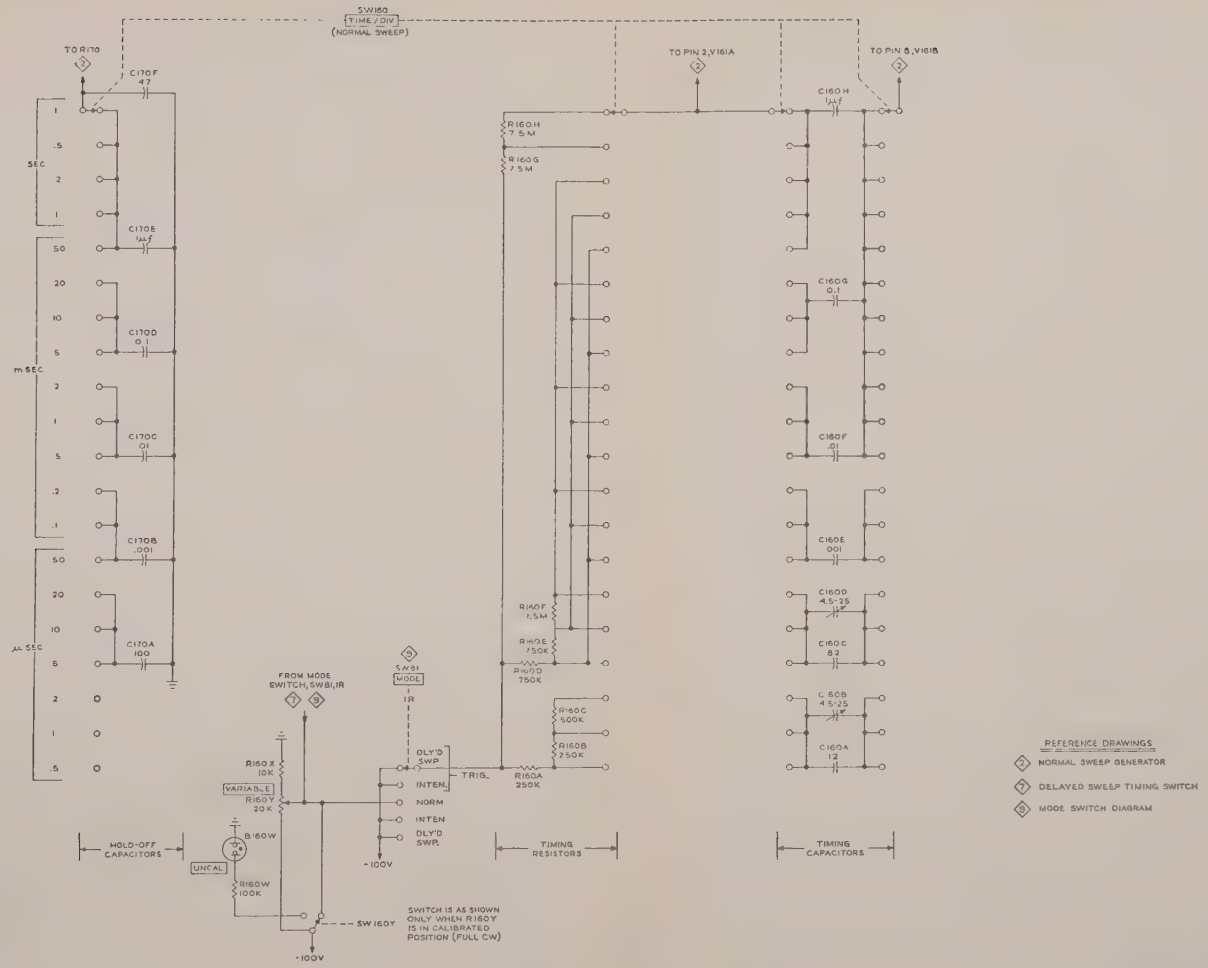
C2

. NORMAL SWEEP GENERATOR

CIRCUIT NUMBERS 100 THRU 199

MRH 565

NORM. SWP. GEN.

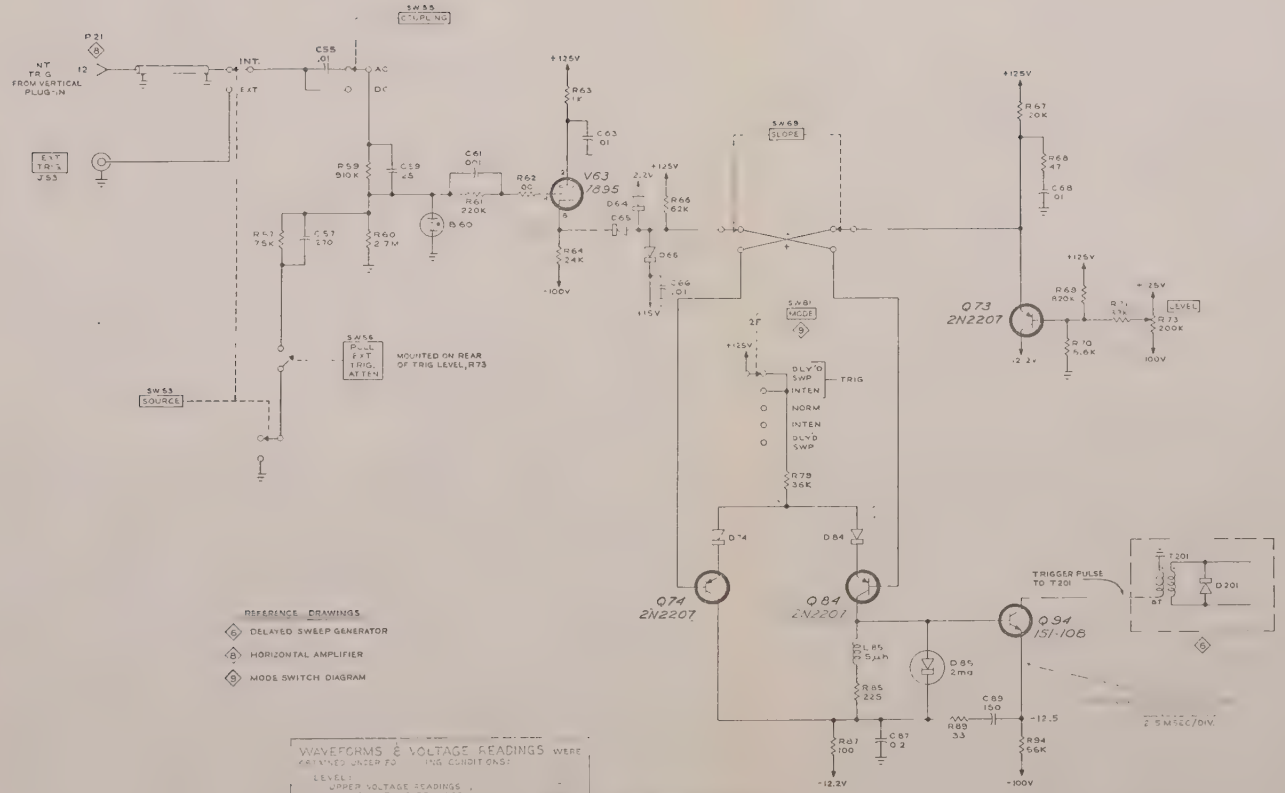


CMD 863

TYPE 383 PLUG-IN

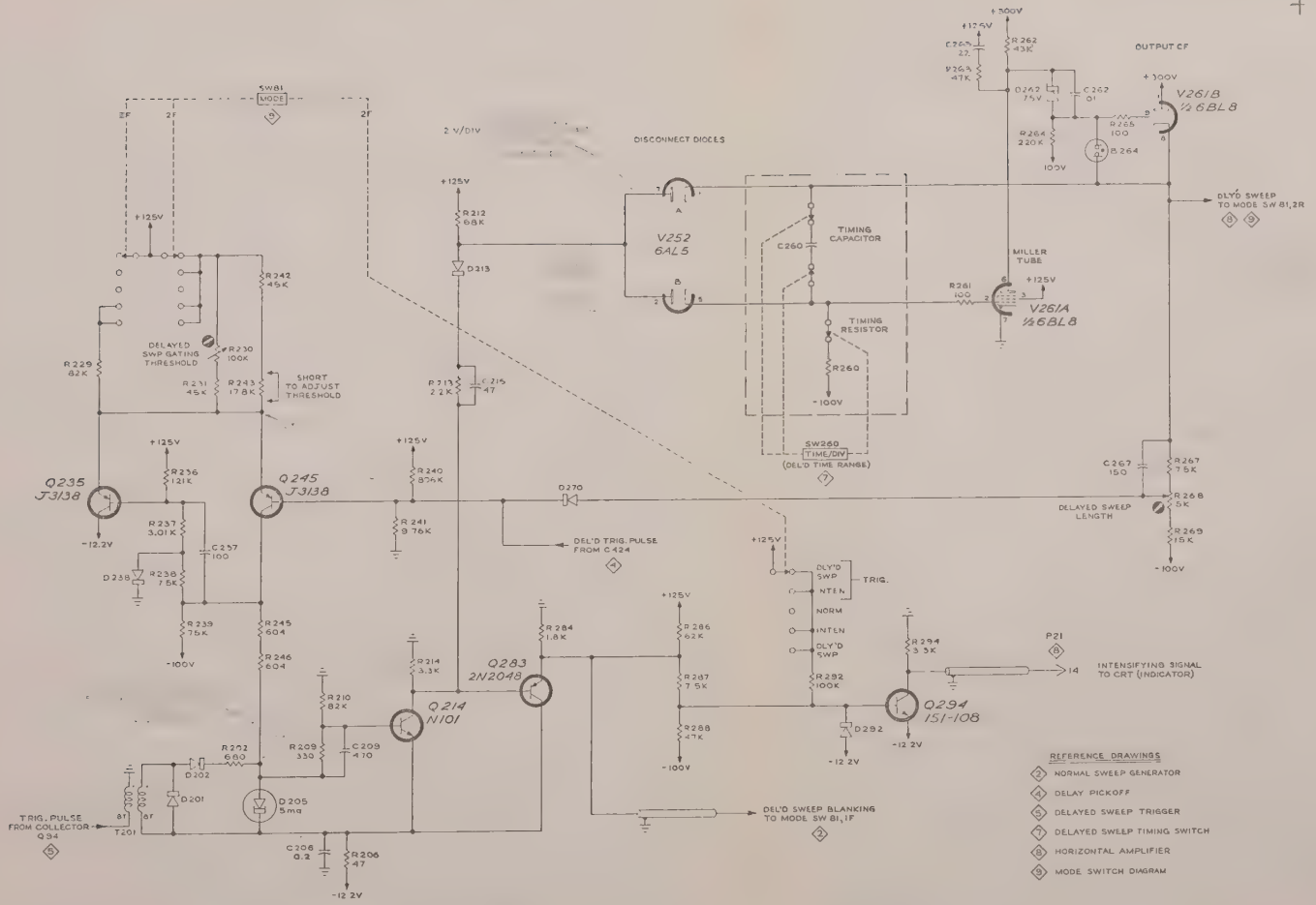
NORMAL SWEEP TIMING SWITCH

NORM SWP. TIM. SW.



TYPE 3B3 PLUG-IN

DELAYED SWEEP TRIGGER



REFERENCE DRAWINGS

- 2 NORMAL SWEEP GENERATOR
- 4 DELAY PICKOFF
- 5 DELAYED SWEEP TRIGGER
- 7 DELAYED SWEEP TIMING SWITCH
- 8 HORIZONTAL AMPLIFIER
- 9 MODE SWITCH DIAGRAM

WAVEFORMS & VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE . . . . . DLY'D SWEEP
TIME/DIV . . . . . 0.5 MSEC

SEE IMPORTANT NOTE ON NORM SWP. TRIG. DIAG.

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

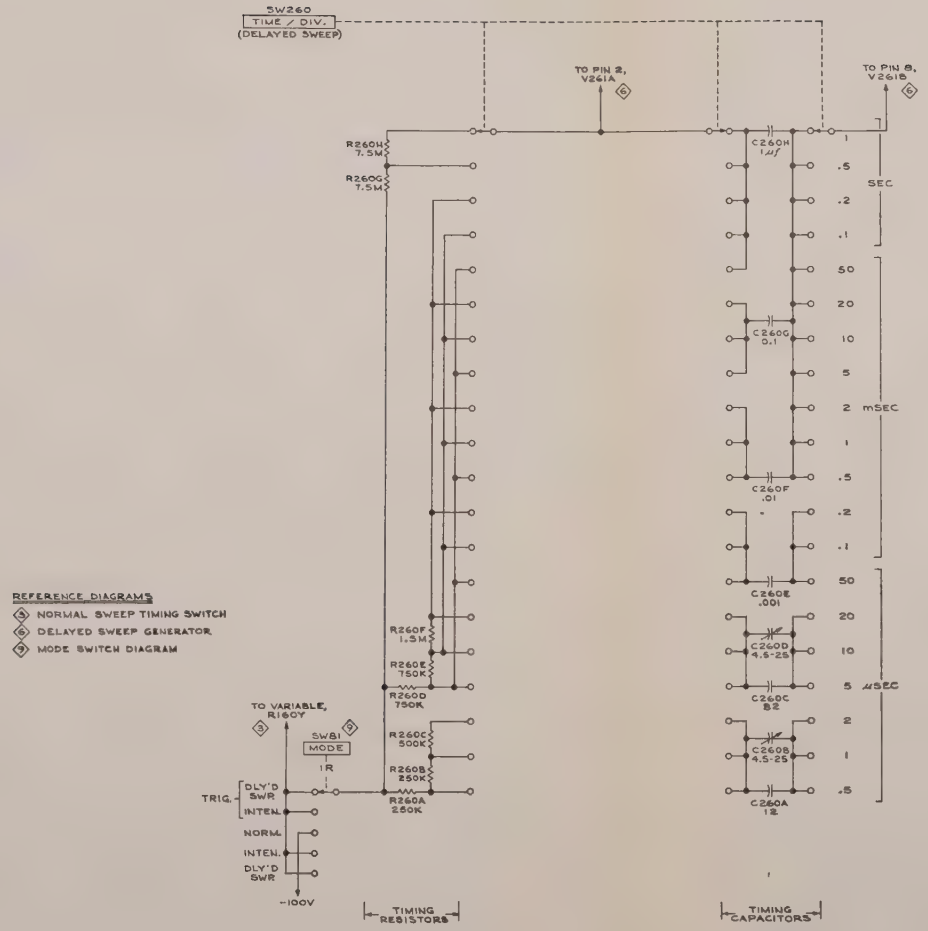
CIRCUIT NUMBERS 200 THRU 299

CMD 864

TYPE 383 PLUG-IN

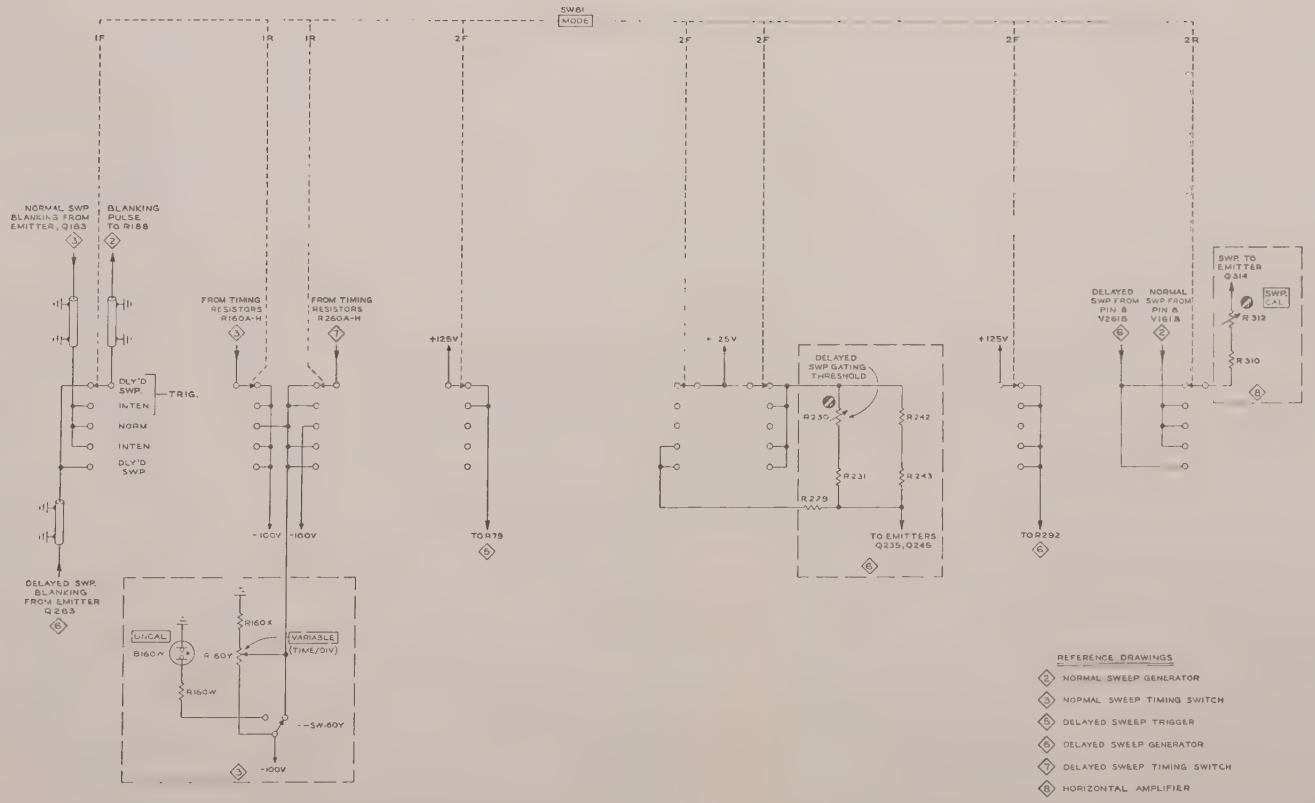
DELAYED SWEEP GENERATOR

DLY'D SWP. GEN.



MRH
863

DELAYED SWEEP TIMING SWITCH



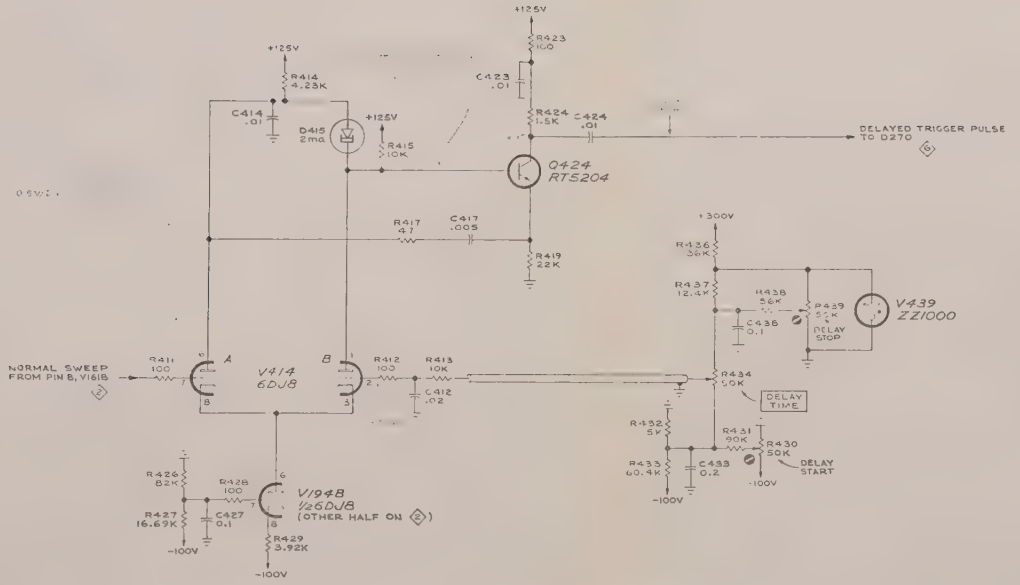
TYPE 3B3 PLUG-IN

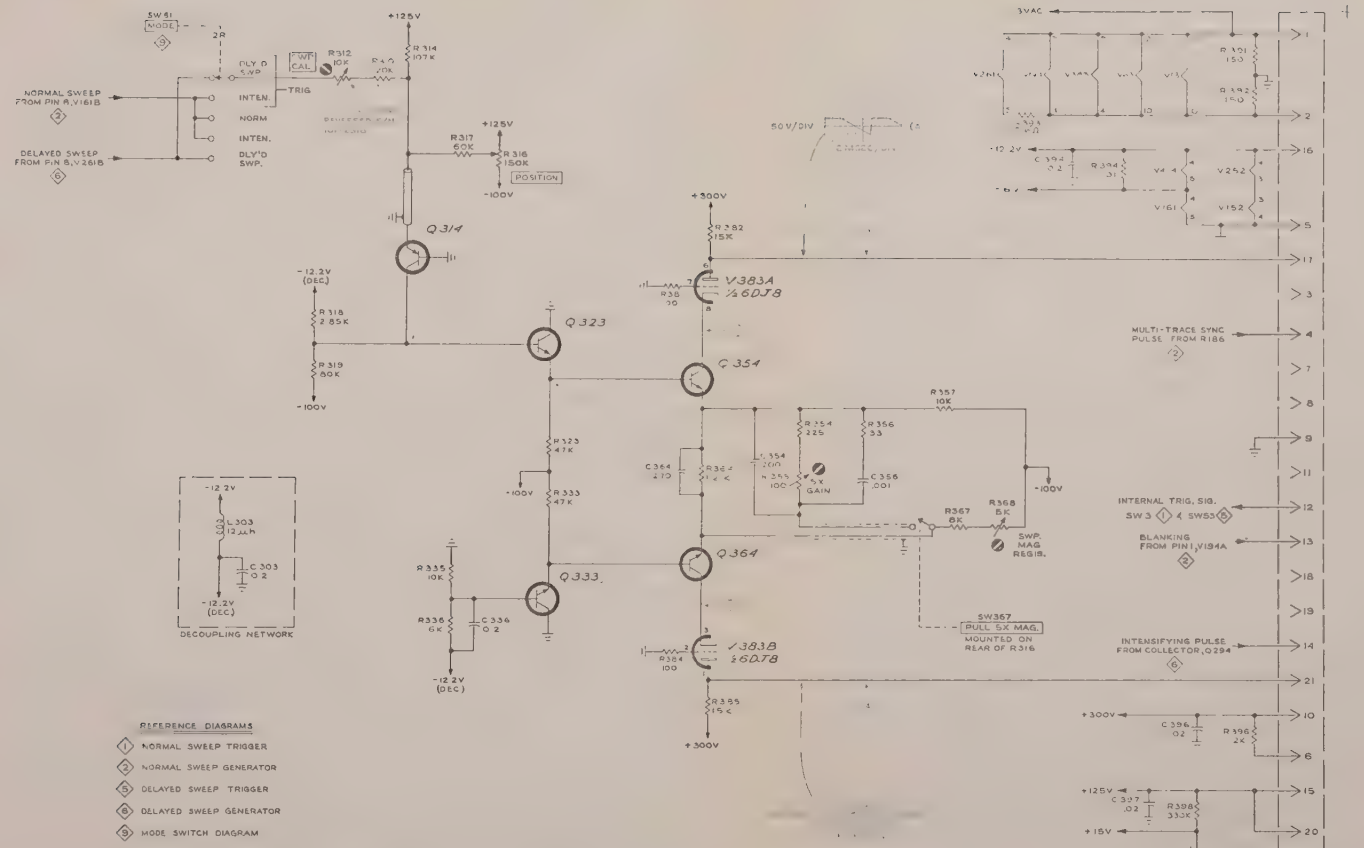
A

CMD 863

MODE SWITCH DIAGRAM

MODE SW. DIAG.


+125V
R423 160
C423 .01
R414 4.23K
C414 .01
D415 2ma
+125V
R415 10K
R424 1.5K
C424 .01
DELAYED TRIGGER PULSE TO D270
6
Q424 RTS204
R417 47
C417 .005
R419 22K
+300V
R436 36K
R437 12.4K
R438 56K
R439 5K DELAY STOP
V439 ZZ1000
C436 0.1
NORMAL SWEEP FROM PIN 8, V161B
2
R411 100
A
V414 6DJ8
B
R412 100
R413 10K
C412 .02
R434 50K
DELAY TIME
R432 5K
R431 90K
R430 50K
DELAY START
R433 60.4K
C433 0.2
-100V
-100V
R426 82K
R428 100
V194B ½6DJ8 (OTHER HALF ON 2)
R427 16.69K
C427 0.1
R429 3.92K
-100V
VOLTAGE READINGS WERE
TIME/DIV & DELAY TIME . . . . . 1 mSEC
DELAY TIME 5.00
SEE IMPORTANT NOTE ON NO. 1 SWP. TRIG. DIAG.
REFERENCE DIAGRAMS
2 NORMAL SWEEP GENERATOR
6 DELAYED SWEEP GENERATOR



REFERENCE DIAGRAMS

1. NORMAL SWEEP TRIGGER
2. NORMAL SWEEP GENERATOR
5. DELAYED SWEEP TRIGGER
6. DELAYED SWEEP GENERATOR
9. MODE SWITCH DIAGRAM

WAVEFORMS & VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:

FOR THIS
UPPER VOLTAGE READINGS . . . . . 10 V
LOWER VOLTAGE READINGS . . . . . 1.0 V
MODE . . . . . NORMAL
TIME/DIV & DELAY TIME . . . . . .1 MS

SEE IMPORTANT NOTE ON NORM SWP. TRIG. DIAG.

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

CIRCUIT NUMBERS 300 THRU 399 CMD

HORIZONTAL AMPLIFIER

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

RACKMOUNTING

General Information

This instrument is designed to fit most 19-inch wide racks with EIA standard dimensions. The instrument front panel requires at least a 7-inch high mounting space.

The last foldout page is a dimensional drawing of the instrument. Any plug-in units, probes, or other accessories that may be used with this instrument are not shown.

Determining the Mounting Method

Use Method 1 if the instrument is to be mounted directly to the front rail of the rack as shown in Fig. 2. Use Method 2 if the instrument is to be mounted in the rack with slide-out tracks and the rack has both front and rear rails (see Fig. 3). Use Method 3 for racks that have only a front rail or do not have the proper dimensions between front and rear rails (see Fig. 4).

Enough space should be provided between the rear of the instrument and any obstruction at the rear of the rack to allow for proper air circulation and power cord clearance. At least 60 cu ft. of air per minute at a temperature less than 50°C should pass through the instrument.

The mounting method will determine the effective panel thickness of the instrument. If the instrument is bolted directly to the rack (Method 1) effective panel thickness will be $^{7}/_{32}$". When slide-out tracks are used, the surface of the instrument panel may be as little as $^{7}/_{32}$" from the rack-mounting surface, or as much as $^{3}/_{4}$", depending on the type of screws used and whether the front flanges of the slide-out tracks are mounted behind the front rail (Fig. 9c) or in front of it (Fig. 8c). For minimum effective panel thickness, countersink flat-head screws into the front rail of the rack. However, this should not be attempted with racks having thin sheet metal mounting rails.

NOTE

If slide-out tracks are used (mounting Methods 2 and 3), the opening between the front rails of the rack must be at least 17 $^{9}/_{16}$" for a rack in which the front flange of the slide-out-track stationary section is mounted behind the front rail as shown in Fig. 9c, at least 17$^{1}/_{2}$" if the flange is mounted in front of the front rail as shown in Fig. 8c; or at least 17$^{13}/_{16}$" if the instrument is mounted in a cradle assembly as shown in Fig. 4.

Method 1—Direct Rackmounting

This type of mounting is intended for instruments which are not equipped with slide-out tracks. The front panel of the instrument has two notches on each side so the instrument can be mounted directly to the front rail of the rack. Front-panel dimensions and notch locations are shown on the Dimensional Drawing. When mounted in this manner, the rear of the instrument does not need support unless subjected to shock or vibration. Braces can be added at the rear of the instrument if more support is needed.

To mount the instrument directly to the front rails of the rack (see Fig. 2) proceed as follows:

1. Select four oval-head screws (10-32 or 12-24) that match the tapped holes in the rack front rail from the hardware kit. If the holes in the front rail are not tapped, nuts, washers, and longer screws must be used.
2. First, place a cup washer and then a plastic washer on each screw. The plastic washers will protect the instrument front panel.
3. Hold the instrument in the desired position in the rack and fasten securely to the front rail with the oval-head screws.

Method 2—Rackmounting With Slide-out Tracks

An instrument which has slide-out tracks (optional item) can be mounted in a rack which has a rear support rail to which the reversible rear support bracket can be attached. Mounted in this manner, the instrument is located into the rack with the two RELEASE knobs on the front panel. When the instrument is released from the rack, it can be pulled out to the fully extended position (see Fig. 3) and then tilted up or down and locked in one of six positions 45°, 90°, and 105° above or below horizontal. These positions permit most routine maintenance and calibration functions to be performed without removing the instrument from the rack.

The slide-out tracks consist of two assemblies, one for the right and one for the left side. Each assembly consists of three sections as illustrated in Fig. 1. The stationary section attaches to the front and rear rails of the rack and the chassis section attaches to the instrument. The intermediate section fits between the stationary and chassis sections and allows the instrument to be extended out of the rack.

The small hardware components included with the slide-out tracks are shown in Figs. 5 and 6. The hardware shown in Fig. 5 is used to mount the stationary sections to the rack. The hardware shown in Fig. 6 is used to mount the chassis sections to the instrument. Since the hardware included is intended to make the slide-out tracks compatible to a variety of racks, there will be more parts than needed for any installation. Use only the necessary hardware as described in the following procedures.

Chassis Section Installation—Use the following procedure to attach the chassis sections if they are not already installed. See Fig. 6 for installation details.

1. Remove the plug-in units (if any) from their compartments.
2. Remove the bottom dust cover from the instrument.
3. Remove the nut, lockwasher, and flat washer from the eccentric pivot screw on the chassis section. Hold the chassis section parts, including the pivot screw, so the assembly does not fall apart.
4. Mount the assembly so the pivot screw goes into the hole provided and the detent bar assembly is aligned with the prepunched holes on the side of the instrument.
5. Replace the hardware removed in step 3. Do not tighten the nut.
6. Fasten the detent bar assembly to the instrument side using six 8-32 BHS screws. Align the detent bar so it is parallel with the bottom of the instrument before tightening the screws.
7. Turn the pivot screw until the outer slide is parallel to the bottom of the instrument. Hold the screw in this position and tighten the nut.
8. Make sure the detent release knob is screwed tightly into the detent bar.

Stationary Section Installation—The stationary and intermediate sections of the slide-out tracks are shipped as matched sets and should not be separated. The assembly for the right side of the rack is shown in Fig. 1. Use the following procedure to mount both sets. Installation details are shown in Figs. 7, 8, and 9.

1. If the instrument is to be mounted directly above or below another instrument in the rack, select the proper front-rail mounting holes using the measurements shown in Fig. 7.
2. If the mounting holes are tapped for 10-32 screws, the left stationary section can be mounted in front of the rail as shown in Fig. 8c provided the distance between the front rails is a minimum of 17¾". Mount the rear support as shown in Figs. 8a or 8b. Using Fig. 8 as a guide, mount the right stationary section. (Note: If the mounting holes are tapped but the distance between the front rails is less than specified, the mounting holes should be drilled out and the stationary section mounted as described in the following step.)
3. If the mounting holes are not tapped for 10-32 screws, mount the left stationary section behind the front rail as shown in Fig. 9c. Mount the rear support as shown in Figs. 9a or 9b. Using Fig. 9 as a guide, mount the right stationary section.

Instrument Installation—Before installing the instrument, check the alignment of the chassis sections as shown in Fig. 12. Be sure the outer slides are parallel with each other. To install the instrument in the rack, follow the step-by-step procedure given in Fig. 10.

Adjustments—To adjust the slide-out tracks for best operation, use the following procedure:

1. Position the instrument in the rack as shown in Fig. 11. Follow the adjustment procedure given in Fig. 11 to horizontally center the instrument in the rack. To center the instrument vertically, use the same procedure but move the instrument up or down for proper spacing.
2. If the instrument does not slide smoothly (even after the centering adjustment), pull the instrument out of the rack and loosen the screws that hold the rear brackets to the rear rail. Push the instrument completely into the rack and tighten the screws.

Method 3—Rackmounting With a Cradle Assembly

A cradle assembly (optional) can be used to mount the instrument in a rack which has only a front rail or does not not have the proper dimensions between the front and rear rails. The cradle assembly provides a rear support for the slide-out tracks without affecting their operation. Additional bracing should be added to the rear of the cradle assembly if severe vibration or shock is anticipated.

Mounting instructions for this type of installation are included with the cradle assembly. The cradle assembly can be ordered from your Tektronix Field Office or representative.

Maintenance

The slide-out tracks require no lubrication. The special [illegible] surfaces provides permanent lubrication.

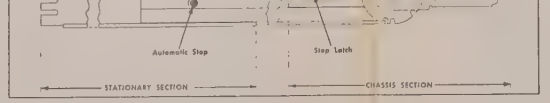


Fig. 1. Slide-out track assembly for right side.

Fig. 2. The instrument mounted directly to the front rail (Method 1).

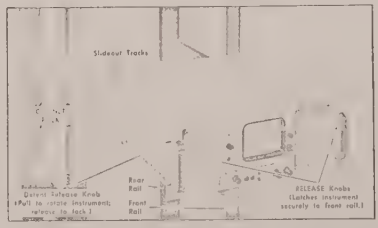

Slide-out Tracks
Detent Release Knob (Pull to rotate instrument; release to lock.)
Rear Rail
Front Rail
RELEASE Knobs (Latches instrument securely to front rail.)

Fig. 3. The instrument mounted with slide-out tracks, supported at front and rear (Method 2).

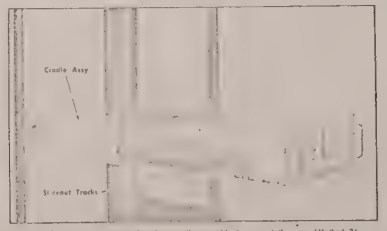


Fig. 4. The instrument mounted with a cradle assembly to support the rear (Method 3).

RACKMOUNTING

General Information

This instrument is designed to fit most 19-inch wide racks with EIA standard dimensions. The instrument front panel requires at least a 7-inch high mounting space.

The last foldout page is a dimensional drawing of the instrument. Any plug-in units, probes, or other accessories that may be used with this instrument are not shown.

Determining the Mounting Method

Use Method 1 if the instrument is to be mounted directly to the front rail of the rack as shown in Fig 2. Use Method 2 if the instrument is to be mounted in the rack with slideout tracks, and the rack has both front and rear rails (see Fig. 3). Use Method 3 for racks that have only a front rail or do not have the proper dimensions between front and rear rails (see Fig 4).

Enough space should be provided between the rear of the instrument and any obstruction at the rear of the rack to allow for proper air circulation and power cord clearance. At least 60 cu ft of air per minute at a temperature less than 50°C should pass through the instrument.

The mounting method will determine the effective panel thickness of the instrument. If the instrument is bolted directly to the rack (Method 1), effective panel thickness will be $\frac{1}{32}$". When slideout tracks are used, the surface of the instrument panel may be as little as $\frac{7}{32}$" from the rack-mounting surface, or as much as $\frac{9}{16}$", depending on the type of screws used and whether the front flanges of the slideout tracks are mounted behind the front rail (Fig 9c) or in front of it (Fig 8c). For minimum effective panel thickness, countersunk flat-head screws into the front rail of the rack. However, this should not be attempted with racks having thin sheet metal mounting rails.

NOTE

If slideout tracks are used (mounting Methods 2 and 3), the opening between the front rails of the rack must be at least 17$\frac{13}{32}$" for a rack in which the front flange of the slideout-track stationary section is mounted behind the front rail as shown in Fig 9c, at least 17$\frac{3}{4}$" if the flange is mounted in front of the front rail as shown in Fig. 8c; or at least 17 $\frac{29}{32}$" if the instrument is mounted in a cradle assembly as shown in Fig. 4.

Method 1—Direct Rackmounting

This type of mounting is intended for instruments which are not equipped with slideout tracks. The front panel of the instrument has two notches on each side so the instrument can be mounted directly to the front rail of the rack. Front-panel dimensions and notch locations are shown on the Dimensional Drawing. When mounted in this manner, the rear of the instrument does not need support unless subjected to shock or vibration. Braces can be added at the rear of the instrument if more support is needed.

To mount the instrument directly to the front rails of the rack (see Fig. 2) proceed as follows:

1. Select four oval-head screws (10-32 or 12-24) that match the tapped holes in the rack front rail. From the hardware kit. If the holes in the front rail are not tapped, nuts, washers, and longer screws must be used.
2. First, place a cup washer and then a plastic washer on each screw. The plastic washers will protect the instrument front panel.
3. Hold the instrument in the desired position in the rack and fasten securely to the front rail with the oval-head screws.

Method 2—Rackmounting With Slideout Tracks

An instrument which has slideout tracks optional item can be mounted in a rack which has a rear support rail to which the reversible rear support bracket can be attached. Mounted in this manner, the instrument is locked into the rack with the two RELEASE knobs on the front panel. When the instrument is released from the rack, it can be pulled out to the fully extended position (see Fig. 3) and then tilted up or down and locked in one of six positions 45° 90°, and 105° above or below horizontal. These positions permit most routine maintenance and calibration functions to be performed without removing the instrument from the rack.

The slideout tracks consist of two assemblies, one for the right and one for the left side. Each assembly consists of three sections as illustrated in Fig. 1. The stationary section attaches to the front and rear rails of the rack and the chassis section attaches to the instrument. The intermediate section fits between the stationary and chassis sections and allows the instrument to be extended out of the rack.

The small-hardware components included with the slideout tracks are shown in Figs. 5 and 6. The hardware shown in Fig. 5 is used to mount the stationary sections to the rack. The hardware shown in Fig. 6 is used to mount the chassis sections to the instrument. Since the hardware included is intended to make the slideout tracks compatible to a variety of racks, there will be more parts than needed for this installation. Use only the necessary hardware as described in the following procedures.

Chassis Section Installation—Use the following procedure to attach the chassis sections if they are not already installed. See Fig. 6 for installation details.

1. Remove the plug-in units (if any) from their compartments.
2. Remove the bottom dust cover from the instrument.
3. Remove the nut, lockwasher, and flat washer from the eccentric pivot screw on the chassis section. Hold the chassis section parts, including the pivot screw, so the assembly does not fall apart.
4. Mount the assembly so the pivot screw goes into the hole provided and the detent bar assembly is aligned with the prepunched holes on the side of the instrument.
5. Replace the hardware removed in step 3. Do not tighten the nut.
6. Fasten the detent bar assembly to the instrument side using six 8-32 BHS screws. Align the detent bar so it is parallel with the bottom of the instrument before tightening the screws.
7. Turn the pivot screw until the outer slide is parallel to the bottom of the instrument. Hold the screw in this position and tighten the nut.
8. Make sure the detent release knob is screwed tightly into the detent bar.

Stationary Section Installation—The stationary and intermediate sections of the slideout tracks are shipped as matched sets and should not be separated. The assembly for the right side of the rack is shown in Fig 1. Use the following procedure to mount both sets. Installation details are shown in Figs. 7, 8, and 9.

1. If the instrument is to be mounted directly above or below another instrument in the rack, select the proper front-rail mounting holes using the measurements shown in Fig. 7.
2. If the mounting holes are tapped for 10-32 screws, the left stationary section can be mounted in front of the rail as shown in Fig 8c provided the distance between the front rails is a minimum of 17$\frac{13}{32}$". Mount the rear support as shown in Figs. 8a or 8b. Using Fig. 8 as a guide, mount the right stationary section. (Note: If the mounting holes are tapped but the distance between the front rails is less than specified, the mounting holes should be drilled out and the stationary section mounted as described in the following step.)
3. If the mounting holes are not tapped for 10-32 screws, mount the left stationary section behind the front rail as shown in Fig 9c. Mount the rear support as shown in Figs. 9a or 9b. Using Fig. 9 as a guide, mount the right stationary section.

Instrument Installation—Before installing the instrument, check the alignment of the chassis sections as shown in Fig. 12. Be sure the outer slides are parallel with each other. To install the instrument in the rack, follow the step-by-step procedure given in Fig. 10.

Adjustments. To adjust the slideout tracks for best operation, use the following procedure.

1. Position the instrument in the rack as shown in Fig. 11. Follow the adjustment procedure given in Fig. 11 to horizontally center the instrument in the rack. To center the instrument vertically, use the same procedure but move the instrument up or down for proper spacing.
2. If the instrument does not slide smoothly (even after the centering adjustment), pull the instrument out of the rack and loosen the screws that hold the rear brackets to the rear rail. Push the instrument completely into the rack and tighten the screws.

Method 3—Rackmounting With a Cradle Assembly

A cradle assembly (optional) can be used to mount the instrument in a rack which has only a front rail or does not not have the proper dimensions between the front and rear rails. The cradle assembly provides a rear support for the slideout tracks without affecting their operation. Additional bracing should be added to the rear of the cradle assembly if severe vibration or shock is anticipated.

Mounting instructions for this type of installation are included with the cradle assembly. The cradle assembly can be ordered from your Tektronix Field Office or representative.

Maintenance

The slideout tracks require no lubrication. The special finish on the sliding surfaces provides permanent lubrication.

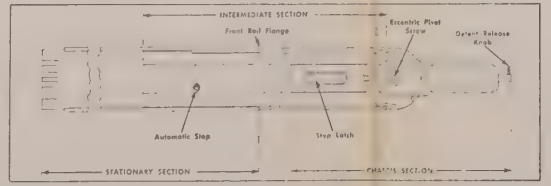


Fig. 1. Slideout track assembly for right side.

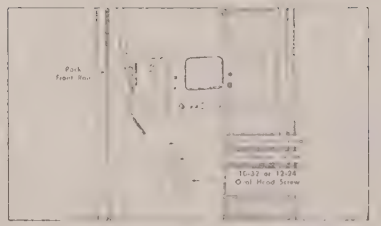


Fig. 2. The instrument mounted directly to the front rail (Method 1).

Fig. 3. The instrument mounted with slideout tracks supported at front and rear (Method 2).

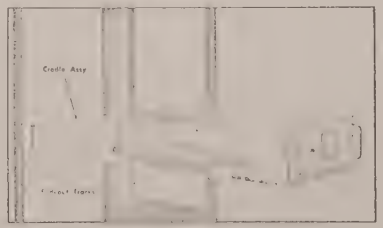


Fig. 4. The instrument mounted with a cradle assembly to support the rear (Method 3).

RACKMOUNTING

General Information

This instrument is designed to fit most 19-inch wide racks with EIA standard dimensions. The instrument front panel requires at least a 7-inch high mounting space.

The last foldout page is a dimensional drawing of the instrument. Any plug-in units, probes, or other accessories that may be used with this instrument are not shown.

Determining the Mounting Method

Use Method 1 if the instrument is to be mounted directly to the front rail of the rack as shown in Fig. 2. Use Method 2 if the instrument is to be mounted in the rack with slide-out tracks, and the rack has both front and rear rails (see Fig. 2). Use Method 3 for racks that have only a front rail or do not have the proper dimensions between front and rear rails (see Fig. 4).

Enough space should be provided between the rear of the instrument and any obstruction at the rear of the rack to allow for proper air circulation and power cord clearance. At least 60 cubic ft of air per minute at a temperature less than 50°C should pass through the instrument.

The mounting method will determine the effective panel thickness of the instrument. If the instrument is bolted directly to the rack (Method 1) effective panel thickness will be $7/32$". When slide-out tracks are used, the surface of the instrument panel may be as little as $5/32$" from the rack mounting surface, or as much as $1/4$", depending on the type of screws used and whether the front flanges of the slide-out tracks are mounted behind the front rail (Fig. 9c) or in front of it (Fig. 8c). For minimum effective panel thickness, countersunk flat head screws into the front rail of the rack. However, this should not be attempted with racks having thin sheet metal mounting rails.

NOTE

If slide-out tracks are used (mounting Methods 2 and 3), the opening between the front rails of the rack must be at least 17 3/8" for a rack in which the front flange of the slide-out track stationary section is mounted behind the front rail as shown in Fig. 9c, at least 17 ¼" if the flange is mounted in front of the front rail as shown in Fig. 8c, or at least 17 1/2" if the instrument is mounted in a cradle assembly as shown in Fig. 4.

Method 1—Direct Rackmounting

This type of mounting is intended for instruments which are not equipped with slide-out tracks. The front panel of the instrument has two notches on each side so the instrument can be mounted directly to the front rail of the rack. Front-panel dimensions and notch locations are shown on the Dimensional Drawing. When mounted in this manner, the rear of the instrument does not need support unless subjected to shock or vibration. Braces can be added at the rear of the instrument if more support is needed.

To mount the instrument directly to the front rails of the rack (see Fig. 2) proceed as follows:

1. Select four oval head screws (10-32 or 12-24) that match the tapped holes in the rack front rail from the hardware kit. If the holes in the front rail are not tapped, nuts, washers, and longer screws must be used.
2. First, place a cup washer and then a plastic washer on each screw. The plastic washers will protect the instrument front panel.
3. Hold the instrument in the desired position in the rack and fasten securely to the front rail with the oval head screws.

Method 2—Rackmounting With Slide-out Tracks

An instrument which has slide-out tracks (optional item) can be mounted in a rack which has a rear support rail to which the reversible rear support bracket can be attached. Mounted in this manner, the instrument is locked into the rack with the two RELEASE knobs on the front panel. When the instrument is released from the rack, it can be pulled out to the fully extended position (see Fig. 3) and then tilted up or down and locked in one of six positions: 45°, 90°, and 105° above or below horizontal. These positions permit most routine maintenance and calibration functions to be performed without removing the instrument from the rack.

The slide-out tracks consist of two assemblies: one for the right and one for the left side. Each assembly consists of three sections as illustrated in Fig. 1. The stationary section attaches to the front and rear rails of the rack and the chassis section attaches to the instrument. The intermediate section fits between the stationary and chassis sections and allows the instrument to be extended out of the rack.

The small-hardware components included with the slide-out tracks are shown in Figs. 5 and 6. The hardware shown in Fig. 5 is used to mount the stationary sections to the rack. The hardware shown in Fig. 6 is used to mount the chassis sections to the instrument. Since the hardware included is intended to make the slide-out tracks compatible to a variety of racks, there will be more parts than needed for this installation. Use only the necessary hardware as described in the following procedures.

Chassis Section Installation—Use the following procedure to attach the chassis sections if they are not already installed. See Fig. 6 for installation details.

1. Remove the plug-in units (if any) from their compartments.
2. Remove the bottom dust cover from the instrument.
3. Remove the nut, lockwasher, and flat washer from the eccentric pivot screw on the chassis section. Hold the chassis section parts, including the pivot screw, so the assembly does not fall apart.
4. Mount the assembly so the pivot screw goes into the hole provided and the detent bar assembly is aligned with the prepunched holes on the side of the instrument.
5. Replace the hardware removed in step 3. Do not tighten the nut.
6. Fasten the detent bar assembly to the instrument side using six 8-32 BHS screws. Align the detent bar so it is parallel with the bottom of the instrument before tightening the screws.
7. Turn the pivot screw until the outer slide is parallel to the bottom of the instrument. Hold the screw in this position and tighten the nut.
8. Make sure the detent release knob is screwed tightly into the detent bar.

Stationary Section Installation—The stationary and intermediate sections of the slide-out tracks are shipped as matched sets and should not be separated. The assembly for the right side of the rack is shown in Fig. 1. Use the following procedure to mount both sets. Installation details are shown in Figs. 7, 8, and 9.

1. If the instrument is to be mounted directly above or below another instrument in the rack, select the proper front rail mounting holes using the measurements shown in Fig. 7.
2. If the mounting holes are tapped for 10-32 screws, the left stationary section can be mounted in front of the rail as shown in Fig. 8c provided the distance between the front rails is a minimum of 17¾". Mount the rear support as shown in Figs. 8a or 8b. Using Fig. 8 as a guide, mount the right stationary section. (Note: If the mounting holes are tapped but the distance between the front rails is less than specified, the mounting holes should be drilled out and the stationary section mounted as described in the following step.)
3. If the mounting holes are not tapped for 10-32 screws, mount the left stationary section behind the front rail as shown in Fig. 9c. Mount the rear support as shown in Figs. 9a or 9b. Using Fig. 9 as a guide, mount the right stationary section.

Instrument Installation—Before installing the instrument, check the alignment of the chassis sections as shown in Fig. 12. Be sure the outer slides are parallel with each other. To install the instrument in the rack, follow the step-by-step procedure given in Fig. 10.

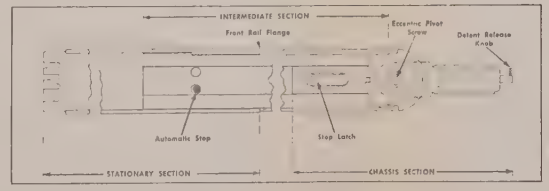


Fig. 1. Slide-out track assembly for right side.

Adjustments—To adjust the slide-out tracks for best operation, use the following procedure:

1. Position the instrument in the rack as shown in Fig. 11. Follow the adjustment procedure given in Fig. 11 to horizontally center the instrument in the rack. To center the instrument vertically, use the same procedure but move the instrument up or down for proper spacing.
2. If the instrument does not slide smoothly (even after the centering adjustment), pull the instrument out of the rack and loosen the screws that hold the rear brackets to the rear rail. Push the instrument completely into the rack and tighten the screws.

Method 3—Rackmounting With a Cradle Assembly

A cradle assembly (optional) can be used to mount the instrument in a rack which has only a front rail or does not have the proper dimensions between the front and rear rails. The cradle assembly provides a rear support for the slide-out tracks without affecting their operation. Additional bracing should be added to the rear of the cradle assembly if severe vibration or shock is anticipated.

Mounting instructions for this type of installation are included with the cradle assembly. The cradle assembly can be ordered from your Tektronix Field Office or representative.

Maintenance

The slide-out tracks require no lubrication. The special finish on the sliding surfaces provides permanent lubrication.

Fig. 2. The instrument mounted directly to the front rail. Method 1.

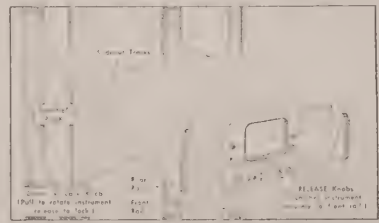


Fig. 3. The instrument mounted with slide-out tracks, supported at front and rear. (Method 2.)

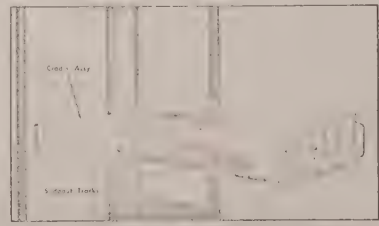


Fig. 4. The instrument mounted with a cradle assembly to support the rear. (Method 3.)

RACKMOUNTING

General Information

This instrument is designed to fit most 19-inch wide racks with EIA standard dimensions. The instrument front panel requires at least a 7-inch high mounting space.

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Determining the Mounting Method.

Use Method 1 if the instrument is to be mounted directly to the front rail of the rack as shown in Fig. 2. Use Method 2 if the instrument is to be mounted in the rack with slide-out tracks, and the rack has both front and rear rails (see Fig. 3). Use Method 3 for racks that have only a front rail or do not have the proper dimensions between front and rear rails (see Fig. 4).

Enough space should be provided between the rear of the instrument and any obstruction at the rear of the rack to allow for proper air circulation and power cord clearance. At least 60 cu ft of air per minute at a temperature less than 50°C should pass through the instrument.

The mounting method will determine the effective panel thickness of the instrument. If the instrument is bolted directly to the rack (Method 1) effective panel thickness will be $^{7}/_{32}$". When slide-out tracks are used, the surface of the instrument panel may be as little as $^{7}/_{32}$" from the rack mounting surface, or as much as $^{3}/_{4}$", depending on the type of screws used and whether the front flanges of the slide-out tracks are mounted behind the front rail (Fig. 9c) or in front of it (Fig. 8c). For minimum effective panel thickness, countersunk flat-head screws into the front rail of the rack. However, this should not be attempted with racks having thin sheet metal mounting rails.

NOTE

If slide-out tracks are used (mounting Methods 2 and 3), the opening between the front rails of the rack must be at least 17-$^{5}/_{8}$" for a rack in which the front flange of the slide-out-track stationary section is mounted behind the front rail as shown in Fig. 9c, at least 17-$^{1}/_{2}$" if the flange is mounted in front of the front rail as shown in Fig. 8c; or at least 17-$^{3}/_{32}$", if the instrument is mounted in a cradle assembly as shown in Fig. 4.

Method 1—Direct Rackmounting

This type of mounting is intended for instruments which are not equipped with slide-out tracks. The front panel of the instrument has two notches on each side so the instrument can be mounted directly to the front rail of the rack. Front-panel dimensions and notch locations are shown on the Dimensional Drawing. When mounted in this manner, the rear of the instrument does not need support unless subjected to shock or vibration. Braces can be added at the rear of the instrument if more support is needed.

To mount the instrument directly to the front rails of the rack (see Fig. 2) proceed as follows:

1. Select four oval-head screws (10-32 or 12-24) that match the tapped holes in the rack front rail from the hardware kit. If the holes in the front rail are not tapped, nuts, washers, and longer screws must be used.
2. First, place a cup washer and then a plastic washer on each screw. The plastic washers will protect the instrument front panel.
3. Hold the instrument in the desired position in the rack and fasten securely to the front rail with the oval-head screws.

Method 2—Rackmounting With Slide-out Tracks

An instrument which has slide-out tracks (optional item) can be mounted in a rack which has a rear support rail to which the reversible rear support bracket can be attached. Mounted in this manner, the instrument is locked into the rack with the two RELEASE knobs on the front panel. When the instrument is released from the rack, it can be pulled out to the fully extended position (see Fig. 3) and then tilted up or down and locked in one of six positions 45°, 90°, and 105° above or below horizontal. These positions permit most routine maintenance and calibration functions to be performed without removing the instrument from the rack.

The slide-out tracks consist of two assemblies, one for the right and one for the left side. Each assembly consists of three sections as illustrated in Fig. 1. The stationary section attaches to the front and rear rails of the rack and the chassis section attaches to the instrument. The intermediate section fits between the stationary and chassis sections and allows the instrument to be extended out of the rack.

The small-hardware components included with the slide-out tracks are shown in Figs. 5 and 6. The hardware shown in Fig. 5 is used to mount the stationary sections to the rack. The hardware shown in Fig. 6 is used to mount the chassis sections to the instrument. Since the hardware included is intended to make the slide-out tracks compatible to a variety of racks, there will be more parts than needed for this installation. Use only the necessary hardware as described in the following procedures.

Chassis Section Installation—Use the following procedure to attach the chassis sections if they are not already installed. See Fig. 6 for installation details.

1. Remove the plug-in units (if any) from their compartments.
2. Remove the bottom dust cover from the instrument.
3. Remove the nut, lockwasher, and flat washer from the eccentric pivot screw on the chassis section. Hold the chassis section parts, including the pivot screw, so the assembly does not fall apart.
4. Mount the assembly so the pivot screw goes into the hole provided and the detent bar assembly is aligned with the prepunched holes on the side of the instrument.
5. Replace the hardware removed in step 3. Do not tighten the nut.
6. Fasten the detent bar assembly to the instrument side using six 8-32 BHS screws. Align the detent bar so it is parallel with the bottom of the instrument before tightening the screws.
7. Turn the pivot screw until the outer slide is parallel to the bottom of the instrument. Hold the screw in this position and tighten the nut.
8. Make sure the detent release knob is screwed tightly into the detent bar.

Stationary Section Installation—The stationary and intermediate sections of the slide-out tracks are shipped as matched sets and should not be separated. The assembly for the right side of the rack is shown in Fig. 1. Use the following procedure to mount both sets. Installation details are shown in Figs. 7, 8, and 9.

1. If the instrument is to be mounted directly above or below another instrument in the rack, select the proper front-rail mounting holes using the measurements shown in Fig. 7.
2. If the mounting holes are tapped for 10-32 screws, the left stationary section can be mounted in front of the rail as shown in Fig. 8c provided the distance between the front rails is a minimum of 17-$^{5}/_{8}$". Mount the rear support as shown in Figs. 8a or 8b. Using Fig. 8 as a guide, mount the right stationary section. (Note: If the mounting holes are tapped but the distance between the front rails is less than specified, the mounting holes should be drilled out and the stationary section mounted as described in the following step.)
3. If the mounting holes are not tapped for 10-32 screws, mount the left stationary section behind the front rail as shown in Fig. 9c. Mount the rear support as shown in Figs. 9a or 9b. Using Fig. 9 as a guide, mount the right stationary section.

Instrument Installation—Before installing the instrument, check the alignment of the chassis sections as shown in Fig. 12. Be sure the outer slides are parallel with each other. To install the instrument in the rack, follow the step-by-step procedure given in Fig. 10.

Adjustments—To adjust the slide-out tracks for best operation, use the following procedure.

1. Position the instrument in the rack as shown in Fig. 11. Follow the adjustment procedure given in Fig. 11 to horizontally center the instrument in the rack. To center the instrument vertically, use the same procedure but move the instrument up or down for proper spacing.
2. If the instrument does not slide smoothly (even after the centering adjustment), pull the instrument out of the rack and loosen the screws that hold the rear brackets to the rear rail. Push the instrument completely into the rack and tighten the screws.

Method 3—Rackmounting With a Cradle Assembly

A cradle assembly (optional) can be used to mount the instrument in a rack which has only a front rail or does not not have the proper dimensions between the front and rear rails. The cradle assembly provides a rear support for the slide-out tracks without affecting their operation. Additional bracing should be added to the rear of the cradle assembly if severe vibration or shock is anticipated.

Mounting instructions for this type of installation are included with the cradle assembly. The cradle assembly can be ordered from your Tektronix Field Office or representative.

Maintenance

The slide-out tracks require no lubrication. The special finish on the sliding surfaces provides permanent lubrication.

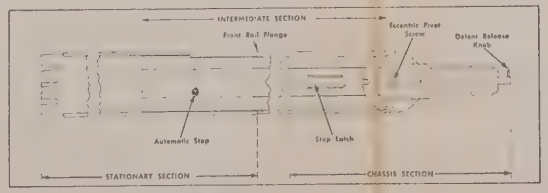

Fig. 1. Slide-out track assembly for right side.

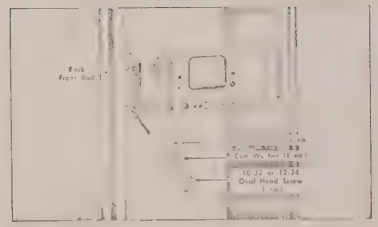

Fig. 2. The instrument mounted directly to the front rail (Method 1).

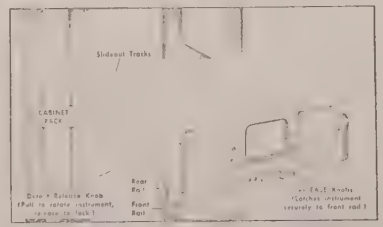

Fig. 3. The instrument mounted with slide-out tracks installed at front and rear (Method 2).

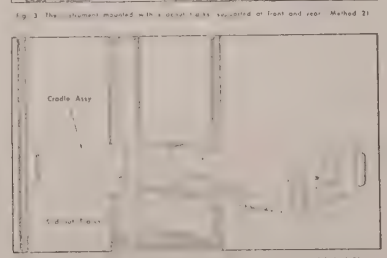

Fig. 4. The instrument mounted with a cradle assembly to support the rear (Method 3).

RACKMOUNTING

General Information

This instrument is designed to fit most 19-inch wide racks with EIA standard dimensions. The instrument front panel requires at least a 7-inch high mounting space.

The last foldout page is a dimensional drawing of the instrument. Any plug-in units, probes, or other accessories that may be used with this instrument are not shown.

Determining the Mounting Method

Use Method 1 if the instrument is to be mounted directly to the front rail of the rack as shown in Fig 2. Use Method 2 if the instrument is to be mounted in the rack with slideout tracks and the rack has both front and rear rails (see Fig 3). Use Method 3 for racks that have only a front rail or do not have the proper dimensions between front and rear rails (see Fig 4).

Enough space should be provided between the rear of the instrument and any obstruction at the rear of the rack to allow for proper air circulation and power cord clearance. At least 60 cu ft of air per minute at a temperature less than 50°C should pass through the instrument.

The mounting method will determine the effective panel thickness of the instrument. If the instrument is bolted directly to the rack (Method 1), effective panel thickness will be 7/32". When slideout tracks are used, the surface of the instrument panel may be as little as 7/32" from the rack mounting surface, or as much as 3/4", depending on the panel screws used and whether the front flanges of the slideout tracks are mounted behind the front rail (Fig 9c) or in front of it (Fig 8c). For minimum effective panel thickness, countersunk flat-head screws into the front rail of the rack. However, this should not be attempted with racks having thin sheet metal mounting rails.

NOTE

If slideout tracks are used (mounting Methods 2 and 3), the opening between the front rails of the rack must be at least 17 5/8" for a rack in which the front flange of the slideout-track stationary section is mounted behind the front rail as shown in Fig 9c, at least 17 3/4". If the flange is mounted in front of the front rail as shown in Fig. 8c, or at least 17 31/32" if the instrument is mounted in a cradle assembly as shown in Fig. 4.

Method 1—Direct Rackmounting

This type of mounting is intended for instruments which are not equipped with slideout tracks. The front panel of the instrument has two notches on each side so the instrument can be mounted directly to the front rail of the rack. Front-panel dimensions and notch locations are shown on the Dimensional Drawing. When mounted in this manner, the rear of the instrument does not need support unless subjected to shock or vibration. Braces can be added at the rear of the instrument if more support is needed.

To mount the instrument directly to the front rails of the rack (see Fig. 2) proceed as follows.

1. Select four oval-head screws (10-32 or 12-24) that match the tapped holes in the rack front rail from the hardware kit. If the holes in the front rail are not tapped, nuts, washers, and longer screws must be used.
2. First place a cup washer and then a plastic washer on each screw. The plastic washers will protect the instrument front panel.
3. Hold the instrument in the desired position in the rack and fasten securely to the front rail with the oval head screws.

Method 2—Rackmounting With Slideout Tracks

An instrument which has slideout tracks (optional item) can be mounted in a rack which has a rear support rail to which the reversible rear support bracket can be attached. Mounted in this manner, the instrument is locked into the rack with the two RELEASE knobs on the front panel. When the instrument is released from the rack, it can be pulled out to the fully extended position (see Fig 3) and then tilted up or down and locked in one of six positions 45°, 90° and 105° above or below horizontal. These positions permit most routine maintenance and calibration functions to be performed without removing the instrument from the rack.

The slideout tracks consist of two assemblies, one for the left side and one for the left side. Each assembly consists of three sections as illustrated in Fig 1. The stationary section attaches to the front and rear rails of the rack and the chassis section attaches to the instrument. The intermediate section fits between the stationary and chassis sections and allows the instrument to be extended out of the rack.

The small-hardware components included with the slideout tracks are shown in Figs 5 and 6. The hardware shown in Fig 5 is used to mount the stationary sections to the rack. The hardware shown in Fig 6 is used to mount the chassis sections to the instrument. Since the hardware included is intended to make the slideout tracks compatible to a variety of racks, there will be more parts than needed for any installation. Use only the necessary hardware as described in the following procedures.

Chassis Section Installation—Use the following procedure to remove the chassis sections if they are not already installed. See Fig. 6 for installation details.

1. Remove the plug-in units (if any) from their compartments.
2. Remove the bottom dust cover from the instrument.
3. Remove the nut, lockwasher, and flat washer from the eccentric pivot screw on the chassis section. Hold the chassis section parts, including the pivot screw, so the assembly does not fall apart.
4. Mount the assembly so the pivot screw goes into the hole provided and the detent bar assembly is aligned with the two countersunk holes on the side of the instrument.
5. Replace the hardware removed in step 3. Do not tighten the nut.
6. Fasten the detent bar assembly to the instrument side using six 8-32 BHS screws. Align the detent bar so it is parallel with the bottom of the instrument before tightening the screws.
7. Turn the pivot screw until the outer slide is parallel to the bottom of the instrument. Hold the screw in this position and tighten the nut.
8. Make sure the detent release knob is screwed tightly into the detent bar.

Stationary Section Installation—The stationary and intermediate sections of the slideout tracks are shipped as matched sets and should not be separated. The assembly for the right side of the rack is shown in Fig 1. Use the following procedure to mount both sets. Installation details are shown in Figs 7, 8 and 9.

1. If the instrument is to be mounted directly above or below another instrument in the rack, select the proper front-rail mounting holes using the measurements shown in Fig 7.
2. If the mounting holes are tapped for 10-32 screws, the left stationary section can be mounted in front of the rail as shown in Fig 8c provided the distance between the front rails is a minimum of 17 3/4". Mount the rear support as shown in Figs 8a or 8b. Using Fig 8 as a guide, mount the right stationary section. (Note: If the mounting holes are tapped but the distance between the front rails is less than specified, the mounting holes should be drilled out and the stationary section mounted as described in the following step.)
3. If the mounting holes are not tapped for 10-32 screws, mount the left stationary section behind the front rail as shown in Fig 9c. Mount the rear support as shown in Figs. 9a or 9b. Using Fig 9 as a guide, mount the right stationary section.

Instrument Installation—Before installing the instrument, check the alignment of the chassis sections as shown in Fig 12. Be sure the outer slides are parallel with each other. To install the instrument in the rack, follow the step-by-step procedure given in Fig 10.

Adjustments—To adjust the slideout tracks for best operation, use the following procedure:

1. Position the instrument in the rack as shown in Fig 11. Follow the adjustment procedure given in Fig 11 to horizontally center the instrument in the rack. To center the instrument vertically, use the same procedure but move the instrument up or down for proper spacing.
2. If the instrument does not slide smoothly (even after the centering adjustment), pull the instrument out of the rack and loosen the screws that hold the rear brackets to the rear rail. Push the instrument completely into the rack and tighten the screws.

Method 3—Rackmounting With a Cradle Assembly

A cradle assembly (optional) can be used to mount the instrument in a rack which has only a front rail or does not not have the proper dimensions between the front and rear rails. The cradle assembly provides a rear support for the slideout tracks without affecting their operation. Additional bracing should be added to the rear of the cradle assembly if severe vibration or shock is anticipated.

Mounting instructions for this type of installation are included with the cradle assembly. The cradle assembly can be ordered from your Tektronix Field Office or representative.

Maintenance

The slideout tracks require no lubrication. The special finish on the sliding surfaces provides permanent lubrication.

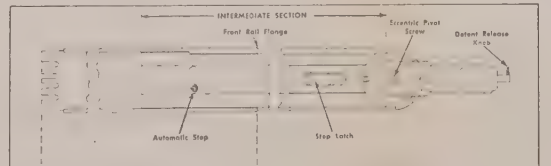

Fig. 1 Slideout track assembly for right side.

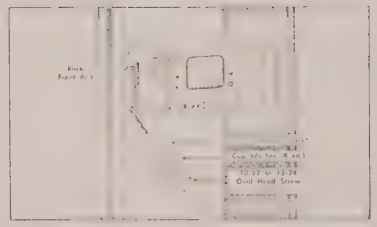

Fig 2. The instrument may be mounted directly to the front rail (Method 1).

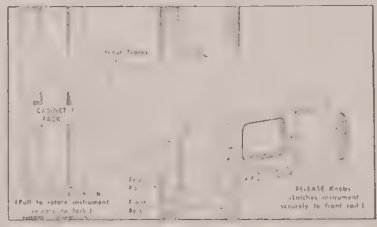

Fig 3. The instrument mounted with slideout tracks supported at front and rear (Method 2).

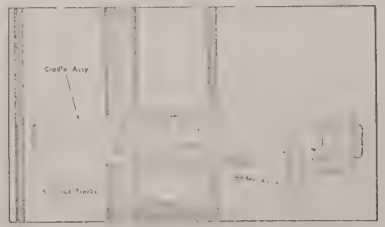

Fig 4. The instrument mounted with a cradle assembly to support the rear (Method 3).

INSTRUCTION MANUAL

MODIFICATION INSERT

Serial Number _____

TYPE RM561A
MOD 236J

This insert has been written to supplement the Instruction Manual furnished with this modified instrument. The information given in this insert will supersede that given in the manual.

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TYPE
RM561A
OSCILLOSCOPE
MOD 236J

Tektronix, Inc.
S.W. Millikan Way • P. O. Box 500 • Beaverton, Oregon • Phone MI 4-0161 • Cables: Tektronix

The Oscilloscope for which this insert was prepared has been modified to provide the following:

The front panel control knobs and graticule cover have been changed to ones with black matte finish. the Front Panel has been changed to a special panel finished by Photo Chemical Products. Special handles have been installed.

Special Rackmounting slides have been installed.

The CAL OUT jack has been moved from the front panel to the rear plate.

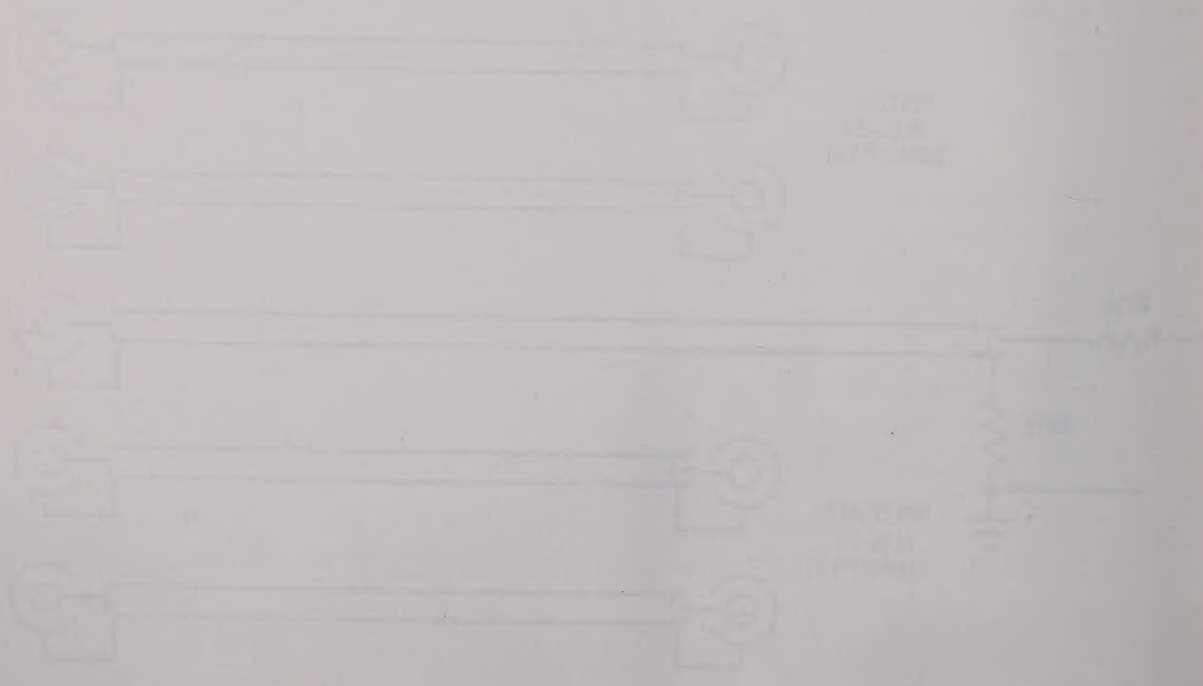
Two Vertical, and two Horizontal inputs have been added to the rear plate. The rear plate BNC connectors are wired to the corresponding plug-in compartment.

CALIBRATION

Calibrate this modified instrument as directed in the Calibration section of the manual. Check the rear plate Cal Out for standard accuracy in all ranges. Check the rear plate Horizontal and Vertical connectors, using the same procedure as for the front panel connectors of the plug-in unit.

Some deterioration of waveform response can be expected due to the increase in lead length and the corresponding increase in input capacitance. The instrument can still be used effectively if allowance is made for changes produced in fast-rise signals.

PARTS LIST CHANGES

The following parts have been added to this modified instrument. When ordering replacement parts, specify instrument type, serial number, and MOD number. Include part number and description of the desired item.

BLOCK, Index, Left	Add	1	030-0089-01
BLOCK, Index, Right	Add	1	030-0090-01
CABLE, Coaxial, RG-174/U	Add		175-0068-00
CONNECTOR, DM-53741-5001	Add	4	036-1000-00
CONNECTOR, Dage 4818-2	Add	5	036-1004-00
COVER, Fuse, Black Matte (200-0237-00)	Change	1	036-3024-00